Editorial

IT is most interesting to read of the Broadcasting Board's decision to increase the power of Australian stations.

In the case of major A class stations, this is to be 50 kw instead of the present maximum of 10 kw, and proportionate increases are planned to include B class stations as well. The schedule also mentions further licence grants to B class stations.

The higher power proposals in my opinion are well overdue. Australia is a difficult country to serve with radio on the basis that everybody should have a choice of good programs. It has so few people in such a wide area that, in contrast to other countries, our broadcast system is a vast and expensive one.

It is pointed out that powers up to 100 kw are likely to be used before long in the Middle East, and when conditions are favorable, our present medium power stations are likely to be jammed by them. But apart from this, higher power will give us better signals over a wider area, and help overcome the nuisance of electrical interference which is a plague to many.

It's hard to see what the end of this interference problem will be. If you are unlucky enough to live near a high voltage distribution line, particularly if the area is a dusty one, you will know what a fearful din can be made by discharges at the insulators. In many cases these are bad enough to spoil even the strongest program.

If some day we are to have television with us, it's hard to see how we can avoid having most serious interference with the pictures from such sources. On the extremely short waves, line electrical noises, ignition systems &c are particularly vicious in their effects. From personal experience, I wonder each time I see these clusters of insulators thrusting over the countryside just how those ing nearby will make out. Interference from an amateur station, for instance, is regarded quite seriously by the powers that be, but no one seems able to do anything at all to stop programs being ruined by the infinitely more troublesome power lines.

With this state of affairs, extra power will mean a proportionately greater field strength at any given point, which is the next best thing to removing the source of interference. It will also be a great help in reducing the effects of static in the summer time, which we are not likely to control by any other means. This, even in the nearby suburbs, is often a bad mutilator of programs.

No mention is made of FM or the possibility of using the VHF bands for broadcasting. Apparently this is no more likely at the present time than television itself. Most people, including the trade, are now reconciled to a long wait, except for a possible experimental TV station which might slowly take shape.

John Moyle

INDEX

RADIO AND HOBBIES IN AUSTRALIA

A NATIONAL MAGAZINE OF RADIO, HOBBIES AND POPULAR SCIENCE

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OUR COVER PICTURE

12-year-old Carol Millett poses in front of the gear on which she trained to pass the FCC permit for a US novice transmitting licence. She is believed to be one of the world's youngest "hams."

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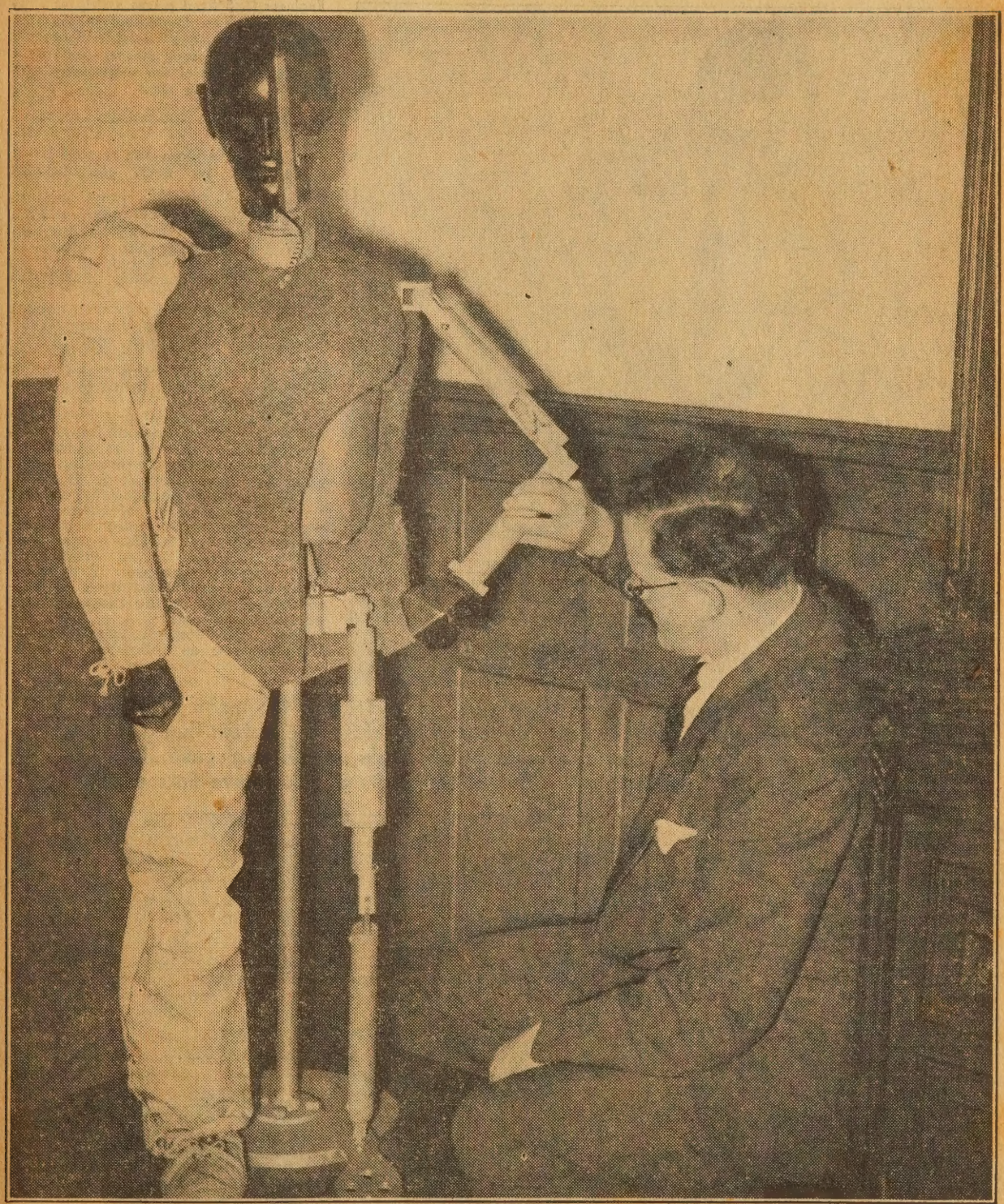
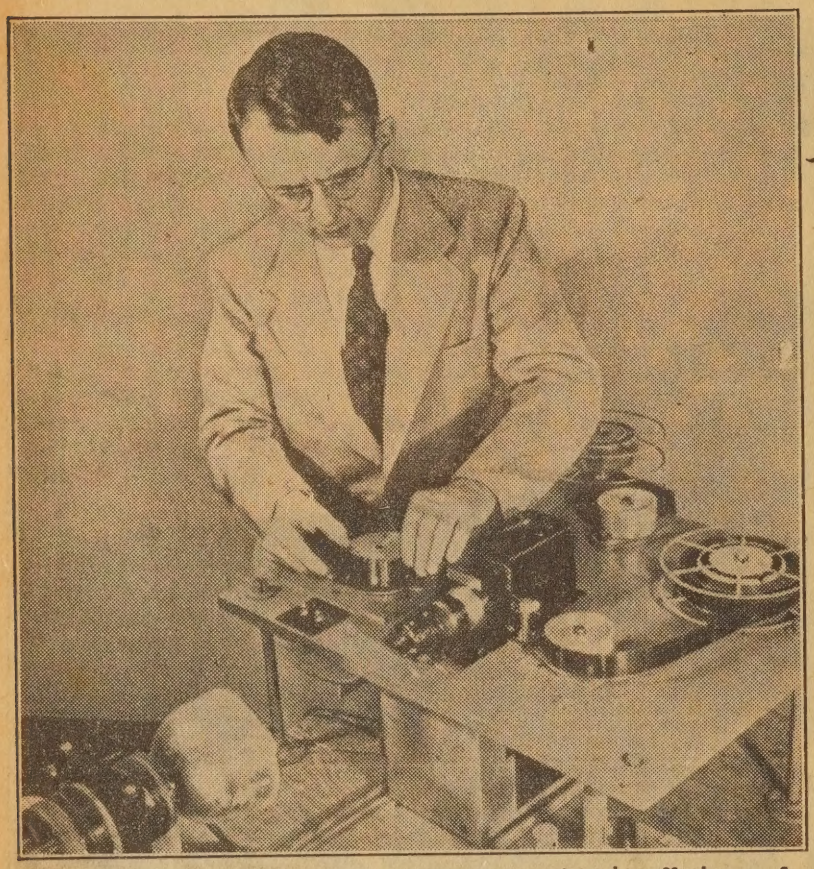


Designed by the G.Q. Parachute Company and manufactured in England by The Hairlok Co. Ltd., this dummy man is intended to react under stress like the human body. With a skeleton of steel, loaded with lead and covered with rubberised foam, the dummy's limbs will break and chest crush under stresses which would similarly affect a pilot, when abandoning a high-speed plane in flight. The dummies weigh 182lb and cost £150 each to produce. They are expected to yield more accurate results than types of dummies hitherto employed.

ULTRAFAX COULD SEND A MILLION



Engineer D. S Bond places a strip of the film to be transmitted in the scanning device. A pin-point of light from the flying spot scanner (left) scans the surface of the continuously moving film.

The possibility of bouncing microwave signals off the surface of the moon to points thousands of miles away highlights the potential value of Ultrafax—the system that can transmit and record documents, maps, pictures, even complete books, at lightning speed. Lunar transmission may extend its range far beyond the normal limits of microwave links and cables.

IN our age of constantly shrinking spaces, with trans-continental ties growing ever closer, the telegraph and telephone cannot cope with our needs in the field of transmitting information.

To be sure, messages can be transmitted, decoded and typed automatically by high speed telegraphy, but every word has to be transcribed in the first instance on to tape. What's more, the tape at the far end has to be mounted and then either re-typed or re-set, if required in duplicate or printed form.

Diagrams and pictures, too, can be reproducted automatically half-way around the world by international wire-photo or radio-photo services, but the process is comparatively slow and expensive.

Imagine the cost and the waste of man-hours which might be involved in transmitting a whole mass of mixed data from one remote point to another by such conventional means.

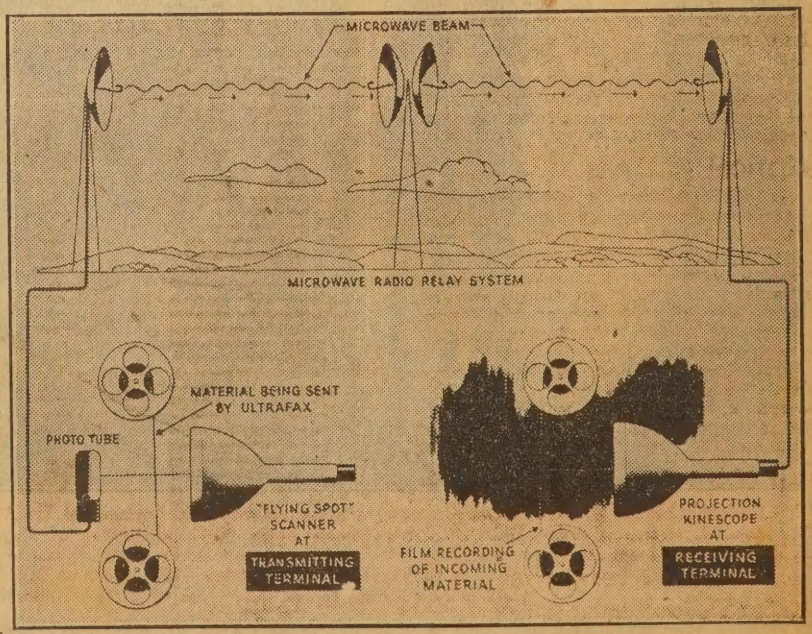
What an advantage to be able to transmit something equivalent to a complete novel or an instruction manual in no more than a minute of time and have it received in a form suitable for immediate photo-litho reproduction.

The growing need may well be met by the combination of the latest VHF transmission techniques and "Ultrafax"—an apparatus which can reproduce with lightning speed anything from a written word to a typographical drawing.

Ultrafax was developed some time ago at the laboratories of Radio Corporation of America, at Princeton, New Jersey, under the direction of its chief engineer, Donald S. Bond.

The system, in its principle, is based on the combining of high-speed photography with radio and television relaying. The remarkable speed which Ultrafax attains is made possible because full pages of information are transmitted as television pictures at the rate of thirty pictures a second.

The main steps in operation of Ultrafax are as follow:



Illustrating the complete Ultrafax system. Television techniques are employed to transmit and record a rapid series of complete "still" pictures.

WORDS PER MINUTE VIA THE MOON

(1) Scanning of previously prepared material by a television scanner at the sending terminal.

(2) Transmission of the television image as ultra-high radio-frequency signals over a micro-wave relay system.

(3) Reception of this television image on a projection-type television kinescope, or "picture tube," from which incoming messages are recorded on motion picture film.

At the end of transmission, the Ultrafax film may be enlarged to full-size copy by means of a high-speed continuous processing machine, similar to that used during the war for V-mail. This "television-radio-photography" combination forms the basis for a system of graphic communication, which may well be extended from city to city, continent to continent, all over the world.

If necessary, transmissions can be "scrambled" for reasons of secrecy, exactly as in conventional telegraph circuits.

NEW OPPORTUNITIES

Its inventors claim that Ultrafax, which utilises each fraction of a split second for high-speed transmission, is as significant a milestone in the field of communication as was the splitting of the atom in the world of energy. Its importance lies in the fact that it will open countless new opportunities for other developments.

Apart from its obvious application to books and documents, the Ultrafax system brings into the realm of reality the idea of an international exchange of television programs on a transoceanic basis. The perfection of Ultrafax will also make possible the establishment of great publications as national institutions by bringing various types of printed matters instantly into every home equipped with a television set.

Another aspect of Ultrafax' usefulness will come in the field of world-wide military communications. Its engineers maintain that ten Ultrafax transmitters could relay, within one single minute, all the military messages cleared from Washington during the 24 hours period at the height of World War II.

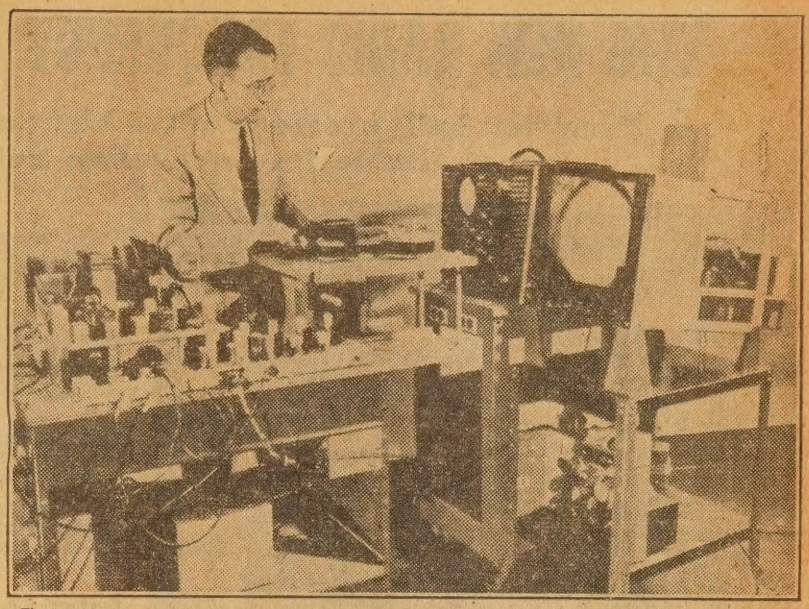
MOTION PICTURES

It may still sound like a fantasy of the future and yet, in a couple of years it will be possible to transmit through Ultrafax a full-length motion picture from one single negative in the production studio simultaneously to the screen of thousands of motion picture theatres throughout the world.

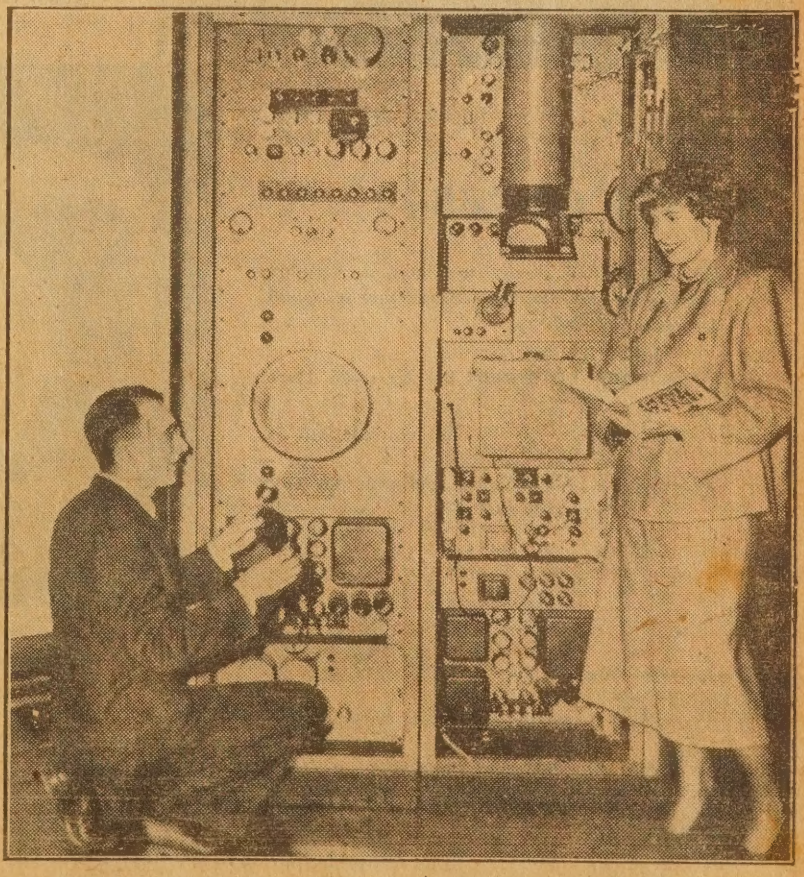
One does not need the imagination of a Jules Verne to visualise the day when a big Hollywood movie will be previewed simultaneously at a cinema on the Champs Elysees, at a Broadway theatre and on the screen of a little flicker-house in Bombay.

The first demonstration of Ultrafax took place at the US Library of Congress in Washington, with many representatives of the Government, the armed forces, industry and Press

(Continued on Page 101)



The complete experimental sending equipment developed by RCA engineers. In a finished commercial version, conventional rack mounting would normally be employed.



The development equipment at the receiving end. Images appearing on the face of the kinescope—mounted on the tube at top right—are recorded in rapid sequence by the automati camera placed directly beneath it.

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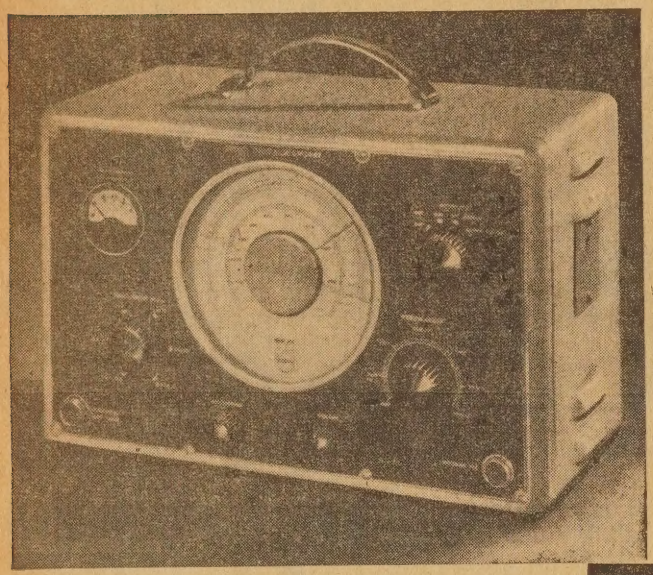


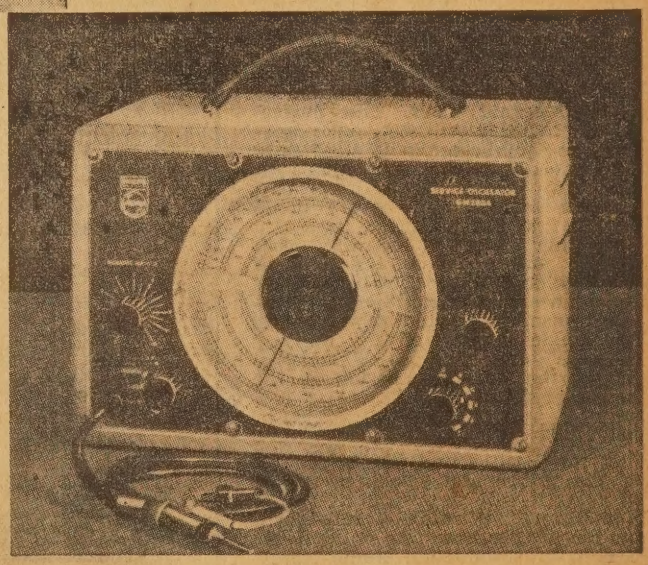
TYPE GM2883

This modulated radio frequency generator is intended for use in radio and communications laboratories and repair workshops.

Frequency coverage: 100 Kc/s—30 Mc/s with a band spread range of 400—500 Kc/s.

Modulation: Internal—400 and 2,500 c/s. External—30—10,000 c/s.

Output: 0—100 mVolts, the stray field radiation being very low. The output cable is fitted with a standard dummy aerial. Audio voltage output also available.



TYPE GM2884

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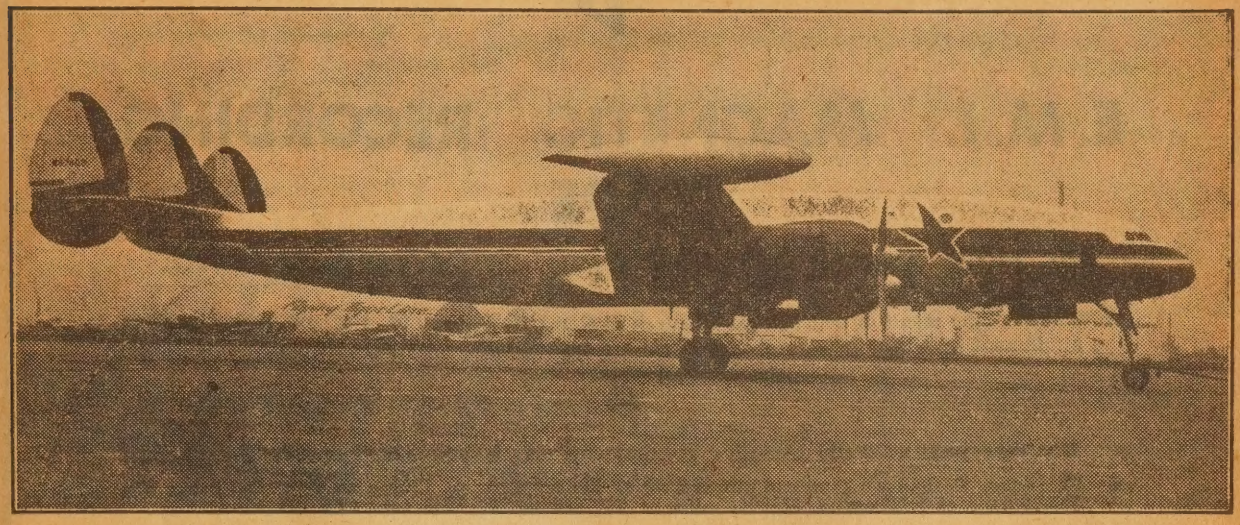
TIP TANKS IMPROVE RANGE AND RIDE



First passenger-carrying aircraft to be equipped with tiptanks is this U.S. Navy version of the Super Constellation..

Air travellers the world over can expect to see large fuel tanks riding like great metallic teardrops on the wingtips of tomorrow's airliners, aircraft designer Clarence L. Johnson reported recently. Johnson, the man who invented tiptanks, is authority for the statement that they are about to graduate into commercial airline use from their present military role. He claims important advantages from their use.

JOHNSON is chief research engineer at Lockheed Aircraft Corporation, Burbank, Calif.

Fuel tanks on the wing ends will first appear on passenger transports when turbo-prop engines come into civilian use, Johnson predicted. When that time comes, perhaps in 1955 or 1956, after earlier military transport use, the tiptank should find ready favor with air passengers for the smoother flight they will produce, he added.

SUPER CONSTELLATION

Lockheed has designed tiptanks for two US Navy Super Constellations which will be powered by new T-34 turbo-prop engines, rated at more than 5000 horsepower each. Transport tanks are now flying on the prototype Super Constellation, a test plane.

First conceived in 1938, tiptanks became standard as auxiliary fuel containers for the early-day F-80 jetfighters.

The F-80 proved what engineers suspected, that tiptanks could make planes fly better. Starting at 40,000 feet, an F-80 with tanks can glide 7 miles farther, without power, than when it has no tanks.

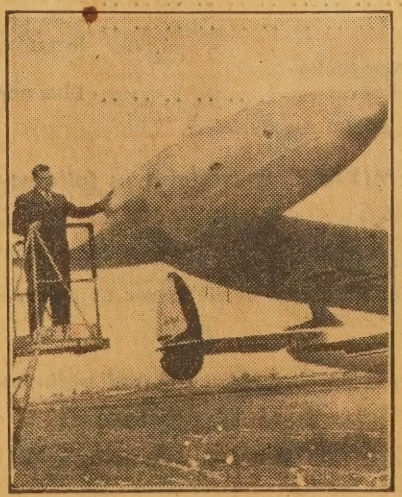
Tiptanks are free riders, costing nothing to haul, Johnson disclosed. The tank develops a lift effect strong enough to compensate for its loaded weight. No speed or payload is sacrificed despite the tank's weight.

Tiptanks on turbo-prop airliners will hold enough extra fuel to make possible long-range flights at cruising speeds of 440 mph or more. Non-stop westbound flights from Shannon, Ireland, to New York are in sight.

Turbo-prop engines, using a jet turbine geared to a standard propeller, consume up to 54.5 p- more fuel than piston engines.

For instance, new Super Constellation transports with latest compound piston engines, due to fly this year as the fastest US transports, will carry 6570 gallons of fuel, mostly in their wings. The same airplane converted to turbo-prop power will require 8770 gallons, a 32 pc increase. Tiptanks will carry 600 gallons each and so-called pod-type tanks hung under each wing will carry 500 gallons each.

"Airplanes of the future are going to develop a lot of protuberances," Johnson declared.



Size of the Constellation's tiptanks is clearly seen in this picture. Each holds 600 gallons.

STRENGTHENS WING

Tiptanks actually strengthen an airplane wing in flight, the designer said, even though loaded 600-gallon tanks weigh 3900 pounds each. That weight counterbalances some of the force always pressing a wing upward during flight. Weight also curbs vibration, tests show.

Tiptanks improve airplane stability in flight, Johnson added. They serve as an end plate, or "fence," to keep air from sliding off the wing end. Tails on the tiptanks themselves also aid stability.

Tiptanks may or may not be required on pure jet transports, Johnson said. Large wings needed by jets may be found adequate to hold all fuel needs in standard tanks, even though consumption may be double what turbo-prop transports will use, according to engineers' calculations.

But if they should be needed, tiptanks can be used even on supersonic transports, Johnson promised. They can withstand faster-than-sound speeds. Lockheed proved that with its experimental XF-90 fighter.

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Coating	.0005"
Total	.0021"
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Elastic Elongation at 1lb	Less than .5%.
Recommended Operation Tension	3oz.
Yield Point	4lb.
Longitudinal Humidity Coefficient	8 x 10 - 3% per % R.H. (40—95% R.H. at 77°F.)
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Remanence	.50 flux lines per ¼".
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WHEN DOES A PLANE GET "TIRED"?

A great deal of trouble is being taken to ensure that United Kingdom aircraft shall not run risks like that which made so tense a situation in the Anglo-American film "No Highway." The airliner in that story was thought to be mechanically perfect by everybody except the apparently mad scientist played by James Stewart. He had calculated that its tail would break after a precise number of flying hours.

* By E. Colston Shepherd

HOW he reacted when he found himself on board the aircraft, which he believed must complete that total before its next landing, made a film of strangely intense interest.

Everybody associated with the building of aircraft recognised the genuine element in the plot of that story. Any metal part will break if a large enough load is applied to it. This breaking load is called its ultimate strength.

The part will also break if a load less than the ultimate strength is repeatedly applied. The smaller this load the larger the number of repetitions needed to produce failure. The parts get "tired," and are said to fail by fatigue. This is not like human fatigue, because it is not cured by a night's rest or, in fact, by a rest of any length.

The onset of fatigue failure is shown by small cracks appearing on the surface. These cracks gradually grow until the part is so much weakened that it breaks.

FLYING CONDITIONS

Now the structure of an aircraft experiences many repetitions of load chiefly from the bumps in flying through gusty weather. Great care has to be taken that the fatigue life of the structure (measured in flying hours) exceeds by a safe margin the time the aircraft is allowed to remain in service.

Nevil Shute, the writer of *No Highway*, the novel from which the film was made, was once an aircraft designer and aware of the years of research which have been done in Britain on the fatigue of aircraft structures.

Most new wing structures are put under vibrational as well as strength tests before they are built into an aircraft. These two tests are different.

For strength, the wing is loaded far beyond the weight it will have to support in the air and the load is generally increased until it breaks so that the actual factor of safety can be found.

For fatigue it is vibrated in a way corresponding to the flexing of the wing in flight through gusts with the object of discovering any risk of its getting tired too soon.

There is no absolute finality about research of this kind in an industry which develops new products at such a rate as the aircraft industry. New designs appear about every five years.

Each new machine seeks in a different way to meet the requirements of the airlines in speed, load, operating height and handling qualities. To determine the probable life of a wing built last year is not necessarily to fix the life of wings which will be built next year. Yet a fund of basic information, from which some general conclusions may be drawn, is already in existence.

For a number of years, the Structures Laboratory of the Royal Aircraft Establishment at Farnborough in Southern England has been at work on this subject.

This is a Government research station. Its data and conclusions are put at the service of all aircraft constructors. They, in turn, present their puzzles to the laboratory so that any proposed departure in design or in the use of new materials can be examined before it is incorporated in a new aircraft.

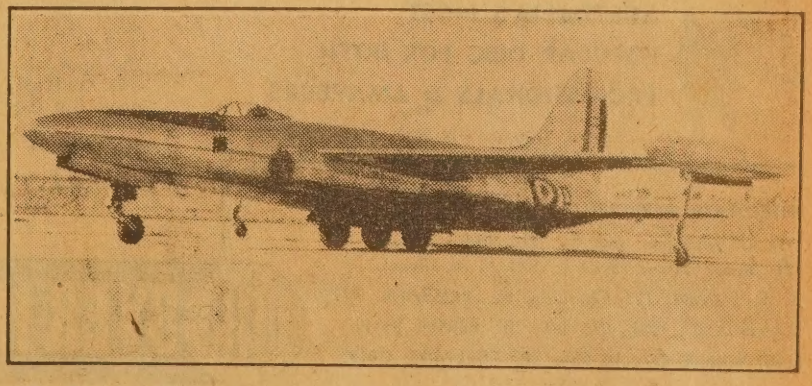
Every aircraft manufacturer I have talked to speaks most highly of the help he gets from Farnborough. But the scientists there are emphatic that new conditions in the use of aircraft mean new tests.

One of the new factors is the longer life of aircraft working on airlines. Whereas they used to become obsolete in about five years they are now expected to last 10 years.

That is intensified by the bigger amount of work they are required

(Continued on Page 17)

The French "Espadon" jet fighter, type SO-6025. It is powered by two Hispano-Mono jets and carries either six 20mm or four 30mm guns in the nose. Pilot's cabin is pressurised, with power ejection. Speed and performance exceeds that of the earlier SO-6201, which was credited with a speed of 621 mph and a practical ceiling of 43,000ft.



The French S.O.M2, an experimental high-speed fighter. Novel undercarriage uses three main wheels, nose wheel and wing-tip skates. Note also the tip tanks. Performance is not disclosed, but the length is given as 30ft, span 33ft and total all-up weight as just over 4½ tons.

* Air Correspondent of the London Sunday Times and well-known aviation commentator.

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NATION-WIDE TV SERVICE FOR USA

The television industry is on the threshold of a vast expansion program. It is ready to bring the glittering lights of Broadway, the dramas of Shakespeare and Shaw, the impromptu debates of world statesmen to the illuminated screens of homes in every part of the nation.

TELEVISION is a regional service, confined mainly to the major population centres. However, the way is being cleared by the government for television to become as much a household commodity as radio, for science has devised a means of broadcasting these signals over a new segment of air waves, as well as those in use, to the farmer, the rancher, and the village miles removed from present TV stations.

Because of this scientific development, the government has proposed the licensing of nearly 2000 new television stations. Towns such as Broken Bow, Nebraska; Eloy, Arizona, and Bad Axe, Michigan, soon may enjoy the same visual programs that millions watch in New York, Chicago and Los Angeles.

NATIONAL SERVICE

In the opinion of Dr. Charles B. Jolliffe, vice-president and technical director of the Radio Corporation of America, this scientific achievement can mean "the advent of a truly nation-wide television service, a service that will provide the main streets of America with the same entertainment, educational and information programs that more densely populated areas have known for several years."

All these programs will come forth on home screens with the same picture fidelity and clarity as in the established television centres of the nation, for there can be enough stations to bring a full-strength video signal within range of nearly everyone. The frequency-allocation plan for this dramatic expansion was developed by the Federal Communications Commission, the government's regulatory agency for all wireless services. It tentatively pinpointed the location for each of nearly 2000 stations as a first step toward offering TV station licences to these communities.

Behind this action is a tale of pioneering by the scientists and engineers of a privately-owned American industry. For years they probed into the mysterious upper regions of the radio spectrum — some scientists call it the "Antarctic" of the air waves— and they determined that television signals could be transmitted successfully through this untapped region.

FEW CHANNELS

All stations functioning today are confined to a relatively narrow band of the spectrum known as the very high frequency range (VHF). It has only a dozen channels for telecasts, not enough to provide blanket coverage.

So the scientists went after the upper regions of radio space, the Antarctic known as ultrahigh frequency (UHF) — and they uncovered a rich lode. Seventy channels which could handle UHF telecasts, together with VHF, this would provide enough room for everybody.

The bulk of this research was done

(FROM NEW YORK)

by scientists and engineers of the Radio Corporation of America and its affiliate, the National Broadcasting Company. Even before the war, they had worked on transmissions in the UHF range, and by late 1949 they were ready to begin regular field tests.

In 1951, after conclusive studies of UHF, these findings were announced:

1. Properly used and properly allocated, television reception of UHF can be just as clear and stable as on VHF. In some instances it is even better, for UHF pictures are not bothered by nearby x-ray equipment, automobile ignitions, neon signs, or home appliances, which have been known to play hob with VHF pictures.

2. Present television sets can be readily adapted to receive both UHF and VHF telecasts.

3. Color television can be broadcast on UHF frequencies.

Much information on which these findings were based came from a small Cape Cod cottage atop a wooded hill on the outskirts of Bridgeport, Connecticut. For two years, field tests on the transmission of television signals in the upper regions of the air waves centred around the cottage. Out of these tests came a new system of video transmission.

In many ways, the cottage is a symbol of pioneering in the 20th century. The knobby hill on which it rests bears the appropriate Yankee name of "Success Hill."

U.H.F. "MECCA"

The cottage has been a prime attraction for government officials, executives in the radio and television industry, and for some of the nation's outstanding electronic scientists, engineers and technicians. Even the Connecticut State police have been lured there for extra-curricular duties.

Since December 30, 1949, the little cottage has housed the first and only ultrahigh frequency television station in the nation operating on a regular daily basis. It has been the field headquarters for the television industry's march into the untapped UHF band.

The station was built as the culminating move in a long campaign to find sufficient space in the air waves for a national television service. A 250ft UHF transmitting tower was erected outside the cottage.

The interior was stocked with television-transmitting equipment. Inside, it looked much like any other station, but its special tubes and circuits were designed by UHF rather than VHF channels.

Bridgeport was picked for the field tests because the undulations of its terrain make line-of-sight television transmission difficult. In addition, it lies in a "fringe" television area, picking up remote signals from New York and New Haven.

Under these extreme test conditions, the Bridgeport station, which bore the experimental deignation of KC2XAK, began picking up the signals of WNBT, the National Broadcasting Company's New York outlet, which broadcasts off the Empire State antenna. These signals, in turn, were rebroadcast via UHF to the Bridgeport area.

To pick up this broadcast, engineers designed and built 50 UHF experimental sets, and 50 tuners to permit present set owners to receive both UHF and VHF telecasts. The test equipment, together with various experimental receiving antennae, was installed in local homes within a 25-mile radius of Success Hill.

In about half the homes, there were no receivers, and servicemen installed both VHF and UHF antennae. This permitted comparison of the pictures picked up direct from New York and New Haven with those beamed over the Bridgeport experimental unit.

SELECTED HOMES

The homes selected for the tests were carefully spotted to obtain a full-area study. Engineers made regular rounds of the test homes over a period of months to analyse the pictures and to compile reception ratings.

Even this was not enough for a full picture. A station wagon was equipped with precise measuring equipment and receivers, and a truck was fitted out with a collapsible antenna that could be quickly elevated. The State police came into the picture here with escorting cars for the mobile unit.

Nearly all the television industry moved into Bridgeport on the invitation of RCA. Sixty-four manufacturers descended on the industrial town to use the UHF signals.

In hotel rooms, homes, stores, and display rooms the technicians of the industry designed and set up equipment to pick up the unwavering signal from Success Hill. They developed tuners to be attached to present sets; they perfected new antennae; they devised effective equipment for combined UHF-VHF reception.

Members of the FCC, headed by the then chairman, Wayne Coy, visited the workshop. Engineers and technicans maintained a steady flow of information into FCC headquarters and, on the basis of this technical data, the plan for a national service began to take shape. In August and September of 1951, Coy and more than a hundred engineers from TV stations throughout America attended demonstrations of the latest UHF equipment. They saw a clear, flickerless picture, brought in by a variety of tuners.

At last UHF was ready. Coy spoke of 3000 television stations in America "soon," with two-thirds to three-quarters in the UHF band.

"I am sold on UHF," the FCC chairman declared, and the industry echoed his words.

ISOTOPES FOR INDUSTRY, MEDICINE

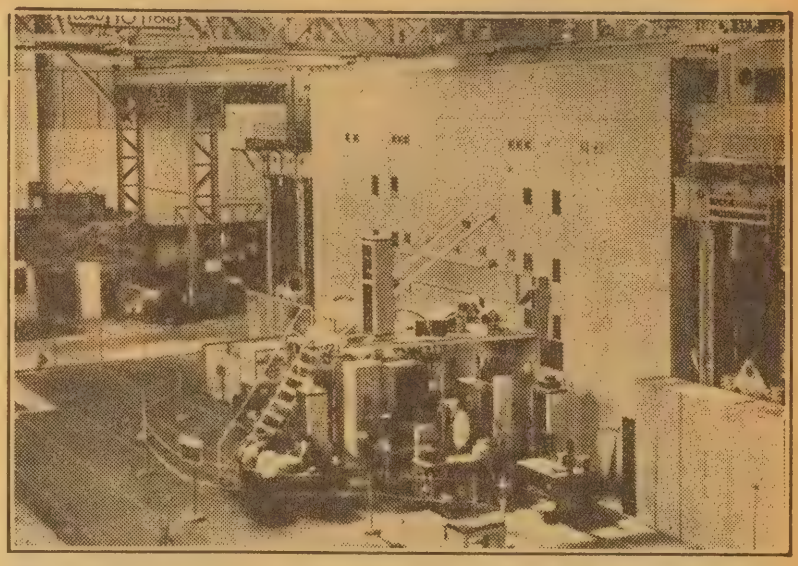
SEARCHING for the cause of psychological illnesses, a number of scientists began a study of the thyroid gland. Slight disorders of this gland may make people too fat or too thin; it can also adversely affect their level of intelligence. No one is certain yet of all the effects of a badly functioning thyroid gland. There is still room for research in treating it.

A study of how the thyroid functions in people suffering from schizophrenia (split personality) is now going on in the West of England. In the same hospital, a parallel investigation is being made into this mysterious gland in patients suffering from other psychotic conditions.

Aiding these studies are those new scientific allies of man from atomic energy-radioactive isotopes.

It is not surprising that efforts are being made to treat Graves' disease with isotopes, for this, too, is an affection of the thyroid gland.

Already, of course, many people have benefited by the medical use of isotopes in the treatment of goitre and in blood circulation diseases — isotopes will trace accurately and swiftly, the circulation of the blood anywhere in the body.



The face of one of the atomic piles at the Atomic Energy Research Establishment at Harwell. The square holes are entrances to the piles, which are built of thick concrete blocks.

Although it has long been the spearhead of Britain's atomic research for defence purposes, the plant at Harwell, in Berkshire, England, has become a prolific source of supply for radioactive isotopes. These radio-energised chemicals are being widely used both for the treatment of disease and for industrial research.

Efforts are also being made to treat that condition of the blood in which there is an excessive increase of white corpuscles (leukemia); and isotopes are being used in an investigation of the tubercle bacteria.

Industrial uses of isotopes from Britain's Atomic Energy Research Establishment at Harwell, in the English county of Berkshire, are now well known.

Photographing the insides of metal components and welds with their penetrating rays is one of them; and now aircraft engines are being examined in this way.

Most of the parcels of isotopes from Hadwell go to the already well-established uses including the dispersion of static electricity in textile manufacture and paper making; the checking of packets of tablets, cigarettes and other commodities on mass production belts.

RISING PRODUCTION

Because of the ever-increasing usefulness of isotopes their production at Harwell is going up accordingly.

In 1949, the total production of parcels of isotopes was 3060, of which 223 went overseas. By 1950, the figure of production had reached 6169, of which 1291 went abroad. To the end of October last, the total production for 1951 was 7244 parcels, and orders from overseas accounted for 1980 of them.

Rising production at Harwell is not completely reflected in the number of deliveries. For use in medical, veterinary and agricultural science, parcels of isotopes are, on the whole, small, and contain material which is active for only a short time. The needs of industry, however, are better served by isotopes with a longer life. Thus, lasting longer, they need less frequent renewal.

In addition, the parcels for industry are usually considerably larger than those for other purposes and they have been rising in size since the Atomic Energy Research Establishment first began supplying them.

Most important overseas customer was France, to which country 83 parcels were supplied in October. Next came Sweden, with 29 parcels, Germany with 24, India with 19, Switzerland with 16, and Belgium with 15. Parcels were delivered to most of the countries in Europe this side of the Iron Curtain, and to many of the countries in the Commonwealth. Total exports for October were 264 parcels.

by Leonard G. Rule

From London

Because of their newness and unfamiliarity, many people in industry hesitate to use isotopes, although they do their particular jobs better and more cheaply than anything else.

SPECIAL LECTURES

The men at Harwell are doing their best to break down this resistance to new methods. "Schools" were organised during the summer at Harwell in which industrial users and potential users could learn the things they needed to know about isotopes. The investigation of the requirements of potential users is a special function of one department at Harwell.

Anyone believing that he can use them in any new way can have his ideas checked by specialists, who will advise on the kind of isotopes best suited and the way in which they should be used.

The great medical value of isotopes tends to overshadow their industrial importance, but already these relatively cheap productions of the atomic piles are replacing costly industrial x-ray apparatus and giving new standards of accuracy in thickness gauges of many kinds of material from plastic sheeting to aluminium foil, and coatings of various kinds on metals.

Though commonly associated with witchcraft and dark caves, the bat does not dislike humans and can be tamed as a pet. This little fellow was kept by an English student to keep down flies and moths in the house.

BATS CAN 'SEE' WITH THEIR EARS

For centuries scientists and others have been baffled by a mystery of the animal kingdom—how bats manage to fly at night without colliding with objects in their path. To a great extent the problem seems to have been cleared up by theories which have been tested but it is nevertheless most interesting.

by Calvin Walters

THERE are many species of bats which manage to get around under the burden of such names as Epitesicus serotinus, Pipistrellus pipistrellus, Rhinolophus hipposideros, Myotis mystacinus, &c., but as the bat seems to be quite oblivious of these names, we will do likewise and refer to them as just plain bats.

Bats are possessed of tiny eyes but they are quite blind in daylight. This gives rise to the saying "as blind as a bat." They can see at night and, for a long time, it was assumed that it was merely by sharp sight that they were able to navigate themselves through all kinds of obstacles at night.

NO ONE CARED

For centuries no one bothered to try and find out otherwise.

Bats fly very rapidly and any observer will note that the course they fly is most erratic. The aim of their flight at night is, of course, in search of food, which consists mainly of insects.

A bat can fly inside a cave which is in absolute darkness without colliding with any object in its path. Under these conditions it must be apparent that no eyesight would possibly be adequate. What is more, the bat will unerringly catch the smallest insect under these conditions.

Most of us have marvelled, too, at the way a bat will avoid such things as comparatively thin telephone wires in their flight at night.

It seems obvious that something more than eyesight is required to enable the creature to direct its navigation.

An Italian scientist Lazzaro Spallanzani discovered, about the end of the 18th century, that a blinded bat could fly around a room and, with ease, avoid the walls furniture and silk threads stretched across the room.

Later a Swiss scientist Louis Jurine found that this ability of the bat to avoid obstacles was completely lost when its hearing was destroyed or interfered with in any way.

Nothing much was done about it until 1920 when a suggestion was put forward by Professor Hartridge that bats navigated themselves by means of supersonic sounds. These sounds could be emitted by the bat and reflected back to their ears.

Again nothing much was done about it until the development of radar and sonar stimulated more research and, in 1940, two scientists working in America proved Professor Hartridge's theory correct.

Simply stated radar is a device which sends a beam of electrical energy through space. When this energy strikes an object, part of it is reflected back to a receiving station. The time taken for this energy to return to the receiver enables the distance to the obstacle to be computed.

Similarly, sonor directs a narrow beam of sound into the air. When this sound strikes an object it is reflected back and the time taken for the echo to return enables the distance of the object to be computed.

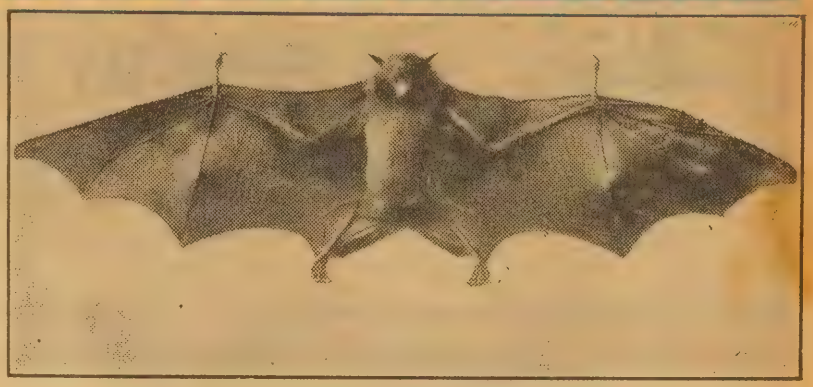
It is by a kind of sonar that the bat is enabled to perform its feats of flight in total darkness. By emitting sound, which is reflected back to its sensitive hearing apparatus, it is enabled to judge distance and direction with such uncanny precision that it can fly at speed without collision with anything in its path.

The range of hearing of the human ear is from about 16 vibrations per second to about 15,000 vibrations per second. Exceptionally good ears can hear vibrations of about 20,000 per second. Any vibration above this can be classed in the supersonic range, namely above the limit of human audibility. The sounds given by bats are from 25000 to 75000 vibrations per second.

The animal has a vocal organ or larnyx quite different from other creatures. Instead of being built of cartilage it is hard, bone and, in comparison to the size of the animal, it is very large and has powerful muscles.

This should not be surprising, as a large amount of energy is required to emit sounds of the supersonic

BIG BROTHER TO THE TINY BAT



The giant fruit bat, known overseas as the "Vampire," from the belief that it sucks human blood. The Australian species boasts the name "Flying Fox." The fingers at the end of each arm controlling the ends of the wing make an interesting comparison with the four fingers and thumb of the human hand.

variety as compared to ordinary sounds.

The higher the vibration the greater the energy required and the larynx of the bat is built just for this purpose.

When the two scientists aforementioned, Griffin and Galambos, began their researches, they firstly confirmed all that was previously discovered about blinded and deafened bats. They found that if both the ears of the bat were covered the animal would not even attempt to fly.

If only one ear was covered it would fly but only with a degree of success in avoiding obstacles.

The next experiment was to cover the mouth and nose of the bat. It was found that the bat could not avoid obstacles which proved that the sounds must be produced by the bats themselves.

With the aid of a supersonic analyser the two experimenters found that the bat emits squeaks of a frequency of about 50,000 cycles per second and that each squeak lasts 1-200th of a second.

A supersonic analyser is an electronic device consisting of a microphone sensitive to supersonic sound, an amplifier which magnifies the sound and a converter which converts the sound to one of lower frequency so that it can be heard on a loudspeaker, or traces a graph on paper through a recorder.

"SQUEAK" RATE

When the bat is resting it emits squeaks at a rate of 10 a second. This is apparently for the purpose of detecting any object such as an approaching enemy, or maybe for the purpose of catching an unwary fly which ventures too close.

It is obvious that when the bat is on the wing it must emit sounds at shorter intervals. The faster it flies, the shorter must be the intervals between squeaks, because the animal must gain information in split seconds if it is to avoid obstacles at high speed or gather up its food.

This is exactly what happens. When the animal first takes to flight the squeaks are emitted at intervals of about 30 per second but, as it approaches an obstacle, the squeaks rise to intervals of 60 per second, dropping again to 30 per second when the danger has passed.

The distance from the bat to the object also governs the rate of the squeaks because there must be a sufficient interval of time for the echo to be reflected back to the bat's ears.

Now you must be ready to ask the obvious question, "How does the bat avoid hearing the squeak it produces thus becoming confused with its own squeak and the echo?"

Certainly the only sound the bat should hear is the echo and, to be sure, it is all arranged.

Those who know something about radar know also that while the transmitter is sending the signal, the receiver is suppressed so that only the echo is picked up by the receiver.

A bat does something like the same thing. While the sound is being emitted a muscle in the ear causes a momentary contraction, thus suppressing the hearing and permitting only the echo being heard.

OTHER SQUEAKS?

Then, of course, there is the question of how the bat does not become confused by the echo from its own squeaks and the echoes from its mate's squeaks or even from the mate's squeak itself. When there are hundreds of bats in a cave or up in the proverbial belfry there must be an awful confusion of supersonic sounds. It is a blessed thing that the sound is supersonic, otherwise church services would be impossible to conduct.

It is known that supersonic sound does not travel very far in air. It is quicly dissipated and it is also known that the sounds emitted by bats die away at about 15ft and can only give a useful echo up to about 12ft. This fact alone would make it a reasonable assumption that, out in the open, there would be little likelihood of one bat confusing its own echo wtih that of its mate's.

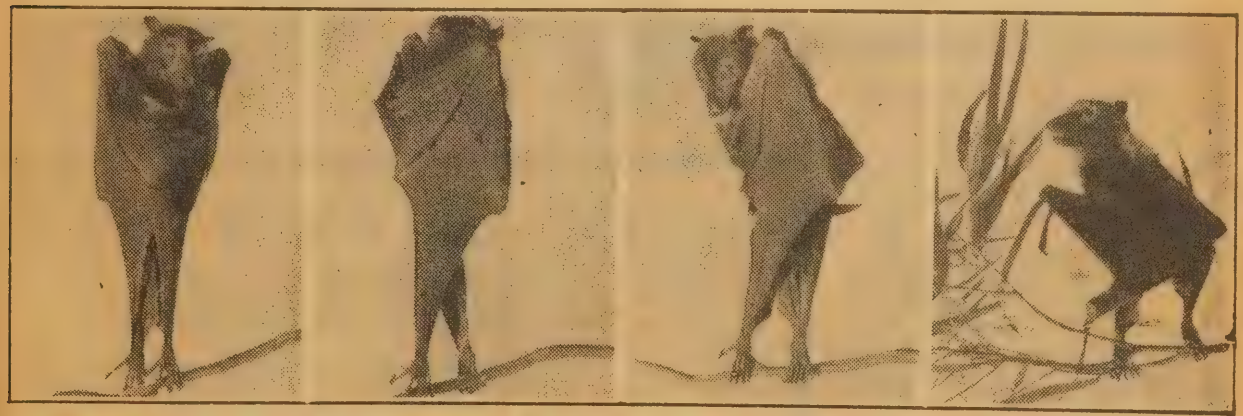
PROBLEM OF FREQUENCY

But when the bats are crammed together in belfries, towers, caves and under roofs, it is a different matter.

Even under these conditions there is no confusion among the animals and the only explanation of this up to date is that each bat must emit a sound of a particular frequency which is essentially its own. Thus each bat would be able to recognise its own voice out of the babel of supersonic sounds.

It would only require a very slight difference of frequency for this to be possible so that positively thousands upon thousands of frequencies would be available.

Whether the bat is born with the different frequency is not known, but it is more reasonable to suppose that



There's only one thing wrong with this remarkable set of pictures . . . they're upside down. Bats prefer to hang rather than stand.

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it adopts the frequency required and may even have to change it when getting into a new group, flock, family, herd or whatever a mob of bats is called.

A bat does not emit only supersonic sounds. There are three other sounds which are used for different purposes.

There is firstly the flight call which is the ordinary voice of the animal. It makes this sound when on the wing and it varies the sound with different types of flight such as level flight, swooping, banking and so on. The different species are distinguished, among other things, by their flight call.

Then there is a buzz which the animal emits and is quite audible when it is close.

The third sound is a click which can be heard at quite a distance from the animal. Both this click and the buzz are emitted at the same time as the supersonic sound. With the buzz the supersonic sound is emitted as a continuous interrupted note while with the click there is one single burst of energy.

Whereas the buzz and click are always accompanied by the supersonic sound the flight call can be sounded either with or without the sound.

Although, as will be seen, considerable progress has been made in solving the mysteries of the bat's flight there are yet quite a few problems to be solved.

We do not yet know whether the bat emits the supersonic sound through the mouth or the nose or both. Practically all bats are insect eaters and, when it catches one, it closes its mouth which is otherwise always open during flight. It is not known whether at that moment echo location ceases with the bat "flying blind" or whether the sound continues to be emitted through the nose.

SOUND FROM NOSE

There is a bat called the greater horseshoe which has a nasal structure suggesting that the sounds are emitted through the nose. Furthermore, this bat's nose is so constructed that it could direct the sound into a narrow beam, thus increasing its position finding ability to a great extent.

This bat has a remarkable judgement of distance and can fly under low roofs at great speed, turn a somersault in mid-air and grasp a perch with its feet wihout slackening speed.

Another question yet unanswered is how a bat knows the difference between an obstable, something good to eat and something not good to eat.

It cannot find its insect prey by sight and up to date there is no evidence that its sense of smell is particularly good. Yet if one throws a piece of wood or a worthless stone into the path of a flying bat the animal will swoop on it and swerve away from it at the last minute without actually touching it.

How does a bat know that there is an insect on something which its echo location must have informed them as an obstacle. Yet the bat can unerringly take the insect without hitting the obstacle.

There are times when echo location ceases for some unknown reason. This appears to be when the animal is entering a hole in the cave where it lives. It is possible to catch bats in this way by placing a net across the hole. By a cessation of echo location the bat will fly right into the net. The hole can even be covered by a thin paper when the bat, unaware of its presence, will fly right through.

During hibernation echo location seems to operate to some extent for, during this period, although asleep, they seem to be aware of the presence of an intruder for a shudder seems to run through them.

Thus one of the mysteries of nature is being unravelled and what has been discovered shows again that man is a long way behind nature in the adaption of natural forces to his own use.

Nature, centuries ago supplied the lower form of life with what man has only quite recently discovered for his own use.

USED FOR MEDICAL RESEARCH

Toward the closing years of the war, small bats were being used in Australia for research into malaria problems. Forty bats kept by the Melbourne University Physiological Department ate 500 worms a day, creating a difficult diet problem.

WHEN DOES A PLANE GET "TIRED"?

(Continued from Page 9)

to do each year. Many a liner in early days flew only 600 hours a year; now they do 2000 to 3000 hours a year.

Another factor is the speed at which they fly. Obviously the impact of a "bump" when travelling at 400 miles (640 kilometres) an hour is heavier than that of the same "bump" at 200 miles (320 kilometres) an hour.

Research into the bumps experienced over all operational routes and at all operational heights is an essential part of the whole problem. This is done by specially designed instruments which count and measure these bumps.

At present the safe life of a structure at the design stage cannot be accurately predicted. So tests, with the added safeguard of the detailed yearly inspection for certificate of airworthiness have to be relied upon.

By studying the results of researches both in the laboratory and in flight scientists are building up a store of knowledge by which specific rules for design for a given total life can be laid down by the licensing authority, known as the Air Registration Board.

That authority is the safeguard of the travelling public. It is composed of aircraft constructors, engineers, scientists, operators, the general public and the insurance interests. Unless that board agrees no aircraft in Britain can fly. And I know that members of that board had considered the possible consequences of fatigue long before Neville Shute wrote *No Highway*.

INK ERADICATOR

A GOOD ink eradicator for ball-point pen ink can readily be made by dissolving a teaspoonful each of common salt and washing soda in a cupful of cold water. Two dessertspoonfuls of bleaching powder (chloride of lime) are then thoroughly well ground up with the resulting solution and the milky liquid is then filtered through fine blotting-paper until almost clear. This will keep in well stoppered bottles for about six to eight weeks.

To use, the solution is dabbed on the writing to be removed which is then followed by a similar application of dilute acetic acid (one in five).

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F.C.M., Ingleburn, NSW.

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Technical Review

LONG DISTANCE VHF COMMUNICATION VIA THE MOON

Another milestone was turned up recently in the history of radio development when a complete message was transmitted on VHF via the moon and between points nearly 800 miles apart. The experiment foreshadows the possibility of long distance television relays and high speed VHF traffic, at suitable times, between remote points on the earth's surface.

On November 8, 1951, ultrahigh-frequency signals that had been reflected from the moon were received by the NBS field station at Sterling, Va., after having been transmitted from Cedar Rapids, Iowa. Those participating in the experiment were P. G. Sulzer, G. F. Montgomery, and Ross Bateman of the Bureau's Central Radio Propagation Laboratory and J. H. Gerks of the Collins Radio Co.

EARLIER WORK

Radio waves had been reflected from the moon before, but they were usually received at or near the point of origin. In the NBS-Collins Radio experiment, on the other hand, the signals were transmitted so as to be received at a site 775 miles from the transmitter after reflection to the moon. The operating frequency was 418 megacycles, generated by a 20-kilowatt transmitter.

Because the transmitting antenna in Cedar Rapids was a fixed structure, lunar reflection could be accomplished only while the disc of the moon was in the beam of radio energy (a period of approximately one-half hour). The antenna at Sterling could be rotated and turned in the direction of maximum signal strength.

Reflection of the signals apparently began as soon as the leading edge of the lunar disc entered the radio beam. The receiving antenna was rotated until the maximum signal strength was obtained—in a position pointing directly toward the moon. As the moon continued to move across the radio beam, the received signal strength increased. About 10 minutes after the initial contact, the signal strength reached its highest value.

The operators in Cedar Rapids then hand-keyed the signal in Morse Code and transmitted the historic message, "What hath God wrought!" The intensity remained at this maximum level for another 10 minutes and then began to decrease as the moon passed out of the radio beam. The greatest signal strength received was about one-millionth as strong as the signal received by most commercial television receivers.

PATH VERIFIED

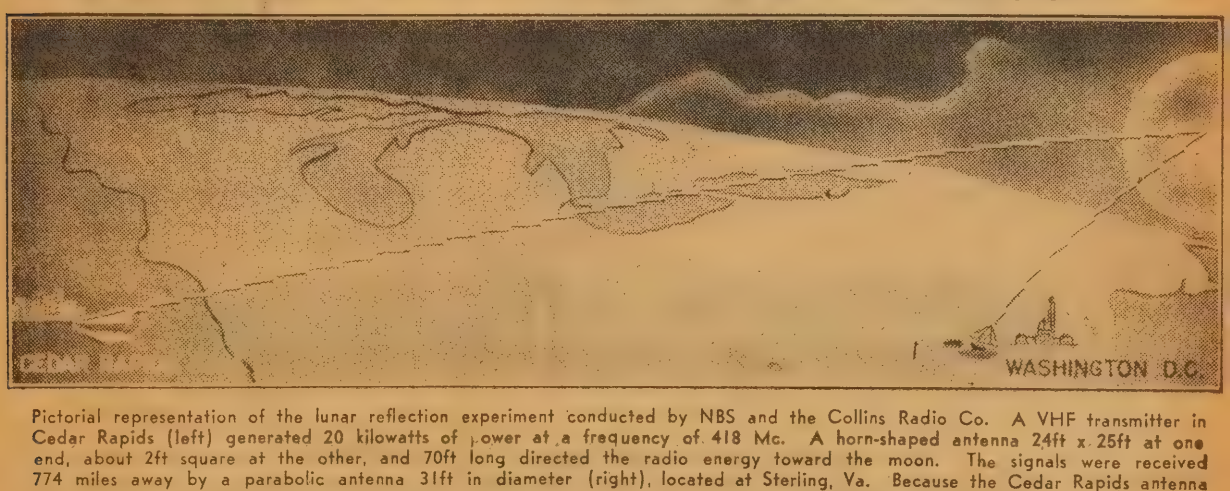
To verify the fact that the signal was reflected by the moon, the actual transmission delay was compared with the theoretical value. This value was determined from the geometry of the experiment—the relative positions of the transmitter, the moon, and the receiver—and the known speed of radio waves. The 2.5-second time interval that was measured agreed approximately with th theory.

The NBS-Collins Radio experi ment thus provides additional in formation confirming the possibilit that the moon can be used as a re flector for short-wave radio trans mission during those times it woul be in the proper position for reflec tion. Use of the moon as a re flector would have the advantag that the transmissions would be fre from interruption.

In present long-range communi cations, the ionosphere is used as reflector. This layer of electrically charged air, 100 to 350 kilometer above the earth's surface, sometime undergoes radical changes during "ionospheric storms." When this happens, the long-range communication is partially or completely interrupted.

If UHF were used, however, employing the moon as a reflector, these radio storms would have little effec on radio transmissions. Moreover the moon would not have to be optically visible to act as a reflector, a clouds or other meteorological conditions do not affect the radio beam seriously.

As a result of these experiments it is believed that a dependable radio system may be possible if the transmitter and receiver were engineered for the specific purpose.



Pictorial representation of the lunar reflection experiment conducted by NBS and the Collins Radio Co. A VHF transmitter in Cedar Rapids (left) generated 20 kilowatts of power at a frequency of 418 Mc. A horn-shaped antenna 24ft x 25ft at one end, about 2ft square at the other, and 70ft long directed the radio energy toward the moon. The signals were received 774 miles away by a parabolic antenna 31ft in diameter (right), located at Sterling, Va. Because the Cedar Rapids antenna was a permanent structure, lunar reflection could only occur while the moon was in the beam. Total time interval between transmitted and received signals was 2.5 seconds for the half-million-mile path.

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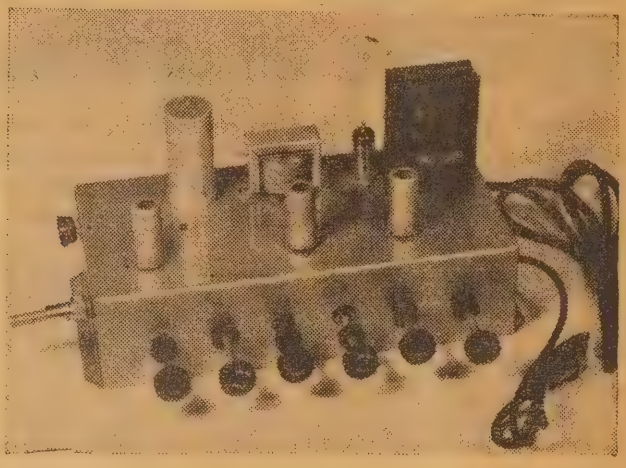
Sound Equipment

MANUFACTURED BY AUDIO ENGINEERS PTY. LTD.



THE WILLIAMSON TONE CONTROL £36/-/-

The Williamson Tone Control (as designed by P. T. N. Williamson) is suitable for use with any Amplifier having an input impedance of .5 megohm or greater and requiring an input Voltage of .25 volts to 2.5 volts.

SPECIFICATIONS

Overall gain 10
Frequency Response 20—20,000 cycles
Input Impedance .5 megohms
Valves — 3; 6AU6; 1, 6X4
Radio Tuner Power Supply—350V at 20m.a.; 6.3V at 2 amps

Sharp cut-off Variable filter provides 40 DB per octave attenuation at 5, 7, 10 and 13 KC.
Bass Control max. cut — 12DB at 20 cycles
max boost + 20DB at 20 cycles
Treble Control max. cut — 17DB at 20,000 cycles
max. boost + 17DB at 20,000 cycles

OUR LATEST MODEL WILLIAMSON AMPLIFIER £49/17/7

Features Single chassis construction. Low hum level. Output Transformer 15 ohms or 3.75, other impedances to order. Uses 2 6SN7GT Valves, 2 KT66 Valves and 1 5V4G Valve.

Audio Engineers Pty. Ltd.

422-424 KENT STREET, SYDNEY. **PHONE: BX6731**

OPEN SATURDAY MORNINGS 9.30 TO 12 NOON

FRENCH OSCILLOGRAPH RECORDS POWER FAILURES

The job of analysing and preventing recurrent breakdowns in power transmission lines is greatly aided if a record is available of potentials and currents in the lines before, during and after a breakdown occurs. A mechanical oscillograph of French design is both simple in operation and effectively "anticipates" breakdowns.

KNOWN as the Masson Carpentier Oscillo-Pertubograph, the instrument is entirely automatic in its operation and has proved extremely reliable in service. Examination of the recorded trace allows the sequence of events in a breakdown to be fixed.

It consists of a watching device, which is continuously in circuit. The printing is switched on by the disturbance occurring and is directly recorded on the strip of paper. The period of recorded printing thereafter can be adjusted between a few seconds and 100 seconds.

The instrument can be fitted with up to seven recording pens, each being used by a separate oscillographic device—recording volts, amps for one phase or a symmetrical component thereof. Alternatively, by a "double top" device, it can record the switching on or off of two voltages or two currents, or the order of tripping of circuit breakers, the action of relays, &c.

SEQUENCE OF EVENTS

By printing the different quantities on the same strip of paper, the order of sequence of the different phenomena are faithfully recorded. In addition, the exact recording of the beginning of the disturbance, taken at two ends of a feeder, allows the information supplied by two instruments to be compared, indicating the point at which the disturbance originated.

The remarkable quality of the Masson-Carpentier oscillograph is that—although the printing is started by the fault occurring, the print records the behavior of the watched quantities about ½ second before the transient disturbance is started. This additional information about the load, the unbalanced conditions, &c, prevailing before the fault will often make easier the analysis of the root cause.

A schematic diagram of the instrument is given in the Fig. 1.

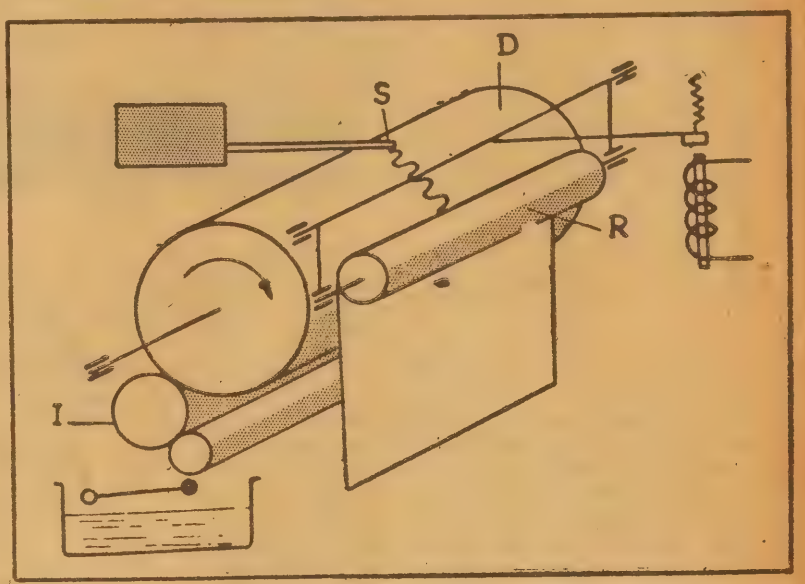
Drum D rotates continuously at a constant speed. A film of special ink is applied by the rolls I and the pen S records the variations of the required quantity. The recording is wiped off by the inking rolls I, as the drum D rotates. Normally, the roll R does NOT touch the drum D and the paper does not move.

When a disturbance occurs, the circuit of a solenoid is closed, whereupon the roll R and the paper are pushed against the drum, so that the pen-scratched curve is printed on the paper strip, which starts unrolling.

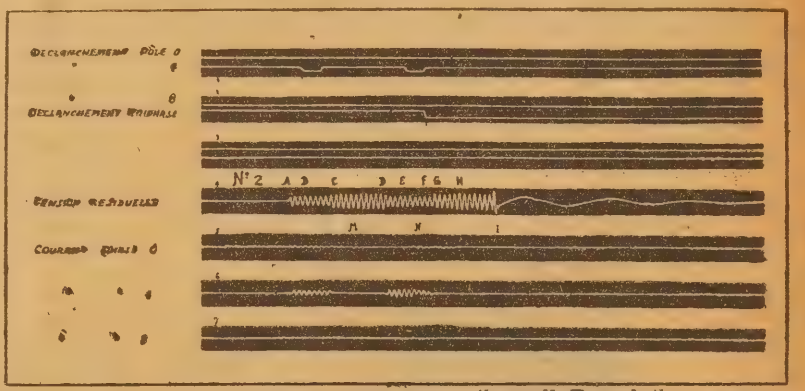
The time taken by a print touched by the pen, to reach the recording paper roll is about ¾ sec. Even with slow relays, the beginning of the disturbance and a period before it can still be recorded. By using electronic relays, disturbances lasting only for a very brief period will be recorded.

The normal speed of unrolling the paper—corresponding to the peripheric speed of the drum—is 100 m/m sec. It can be halved by the interchange of two pinions in the moving mechanism. To limit the unnecessary use of paper, the recording stops automatically after a time—to be adjusted between 10 to 50 sec—after the start of the transient and it restarts for another period of 1½-4½ sec—to record the end of the transient.

(Continued on Page 103)

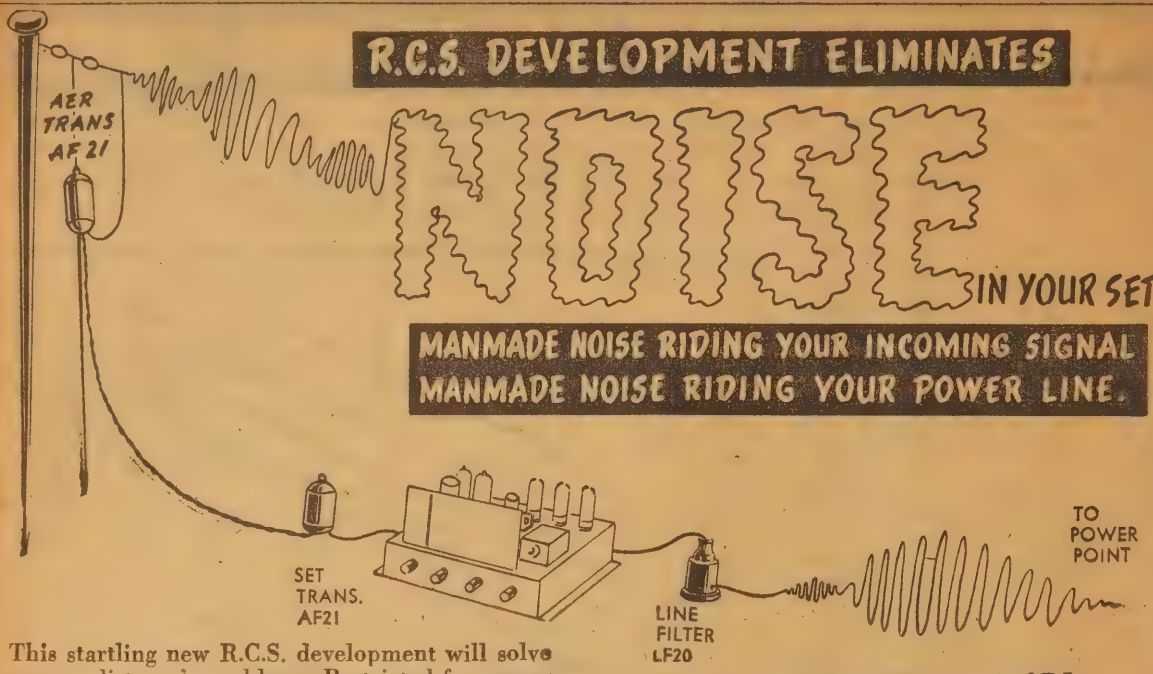


Illustrating (above) the principle of the Masson-Carpentier oscillograph and (below) a strip of the recording paper with engineer's annotations.



USUAL PHOTOGRAPHIC OSCILLOGRAPH	MASSON-CARPENTIER OSCILLOGRAPH
Is not moving continuously, so it can fail just when it is needed.	Rotates continuously, hence always ready to record.
Needs an extra quick relay to start it—with the risk of failing to record the beginning of the transient.	Normal starting relay—even a slow starting relay will ensure the recording of the conditions prevailing ½ sec. before the transient.
Need of photographic development—a long and delicate operation.	Printed diagrams can be used immediately.
Practical impossibility of recording the end of the first transient—if other transients succeed quickly.	Records the end of a transient and any other disturbance arising at any time.

R.C.S. DEVELOPMENT ELIMINATES NOISE IN YOUR SET

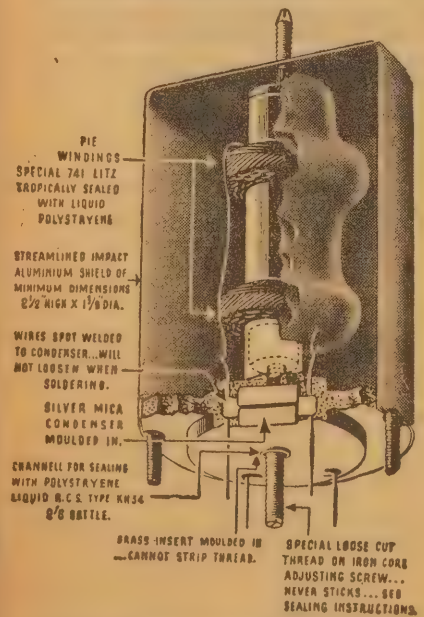


MANMADE NOISE RIDING YOUR INCOMING SIGNAL
MANMADE NOISE RIDING YOUR POWER LINE.

This startling new R.C.S. development will solve many a listener's problems. Restricted frequency range of reproduction or tone, lack of sensitivity due to poor listening levels are unknowingly too frequently caused by man-made local interference, such as blackout and emergency lighting plants cutting in. Servicemen everywhere will tell you that quite a large percentage of sets that are brought in as noisy are faultless. The real trouble, background noise and chatter and poor performance, is due to bad installation and man-made interference entering both the aerial and R.F. stages of the circuit through the aerial terminal and the power line.

FOR TONE AND FIDELITY...

You must use R.C.S. Type 170 and 171 IFs. The couplings in these IFs has been critically adjusted for full frequency response.



If you cannot obtain R.C.S. aerial or line filters from your retailer, please write direct to R.C.S. and we will advise you where they can be obtained or arrange for your retailer to receive supplies.

GET THESE TWO WINNERS AND FIT THEM TODAY!

AERIAL FILTERS
AF21

The aerial filter consists of two transformers—one is situated close to the aerial, the other close to the aerial and earth terminal. Your set requires no alteration whatever and any amateur can fit the R.C.S. aerial filter in half an hour.

LINE FILTER
LF20

The R.C.S. line filter can be installed in a matter of minutes. It cuts in on any convenient position in your power line.

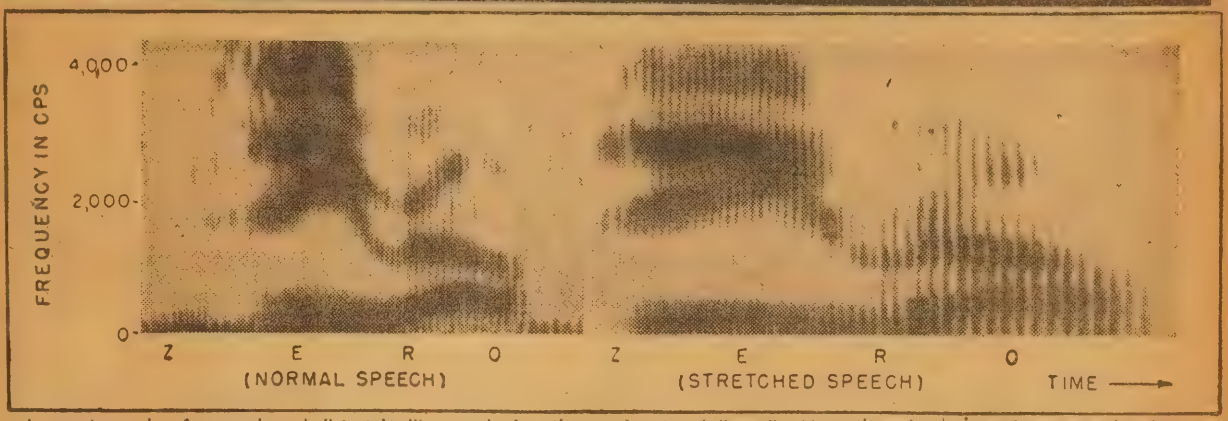
NEW DESIGNS

LF20C	¾ amp Line Filter with Condensers.
LF24C	2 amp Line Filter with Condensers.
K123	10 KC Whistle Filter Coils.
MO20	Whistle Filter Bobbin.
MO1	Iron Core.
MO30	Short Mounting Top.
H139	15 Metre 21 MC Aerial Coils.
H140	15 Metre 21 MC R.F. Coils.
H141	15 Metre 21 MC Oscillator Coil.

R.C.S. AERIAL AND POWER LINE FILTERS

R.C.S. Radio Pty. Ltd., 651 Forest Road, Bexley

"STRETCHES" SPEECH FOR LANGUAGE STUDIES



A spectograph of normal and "stretched" speech for the spoken word "zero." Note that the energy frequency distribution is not greatly altered, but the time scale has been doubled.

The so-called "speech stretcher," developed recently in America by the Kay Electric Co., does for the ear what the slow motion camera does for the eye. It retains the normal inflection and frequency range of speech but slows the rate of reproduction to one half normal.

THE "speech stretcher" offers great possibilities in analysing strange dialects and in transcribing them to phonetic symbols. Inflections can be studied in detail and mimicked with much greater ease, an aspect which is likely to be of particular interest to students of foreign languages.

For stenographic use, the system allows a recording to be played continuously and at a sufficiently slow rate to be taken directly on a typewriter.

Fundamentally, the scheme involves making a recording of the speech on disc, tape or any other suitable medium. This recording is then played back at half normal speed. (No purely electronic circuit yet exists, which can thus double the time scale.)

In the ordinary way, the half-speed playback would reduce the whole pitch of the speech by two-to-one, thereby greatly reducing its intelligibility. Anyone who has played a gramophone at below normal speed will be familiar with this effect.

PROBLEM OF PITCH

The inherent change in pitch may be corrected, however, in one of two ways. In one system, which is easy to grasp, the output from the half-speed playback is taken to a series of audio acceptance filters, each ideally much narrower than an octave in width, but together covering the whole range.

Each of these primary acceptance filters is followed by its own frequency-doubling device and this is followed, in turn, by a secondary band-pass filter one octave higher than the first. The output of all these secondary filters is ultimately combined and amplified to feed the loudspeaker.

For example, a 500-cycle signal would be accepted by a particular primary filter. In the frequency doubler, its frequency would be raised by 1000 cps and, inevitably, certain harmonics generated at 1500, 2000 cps and so on. The 1000 cps note would be passed by the secondary filter but all other components at 500, 2000, 2500 cps and so on would be rejected, since each filter is less than an octave wide.

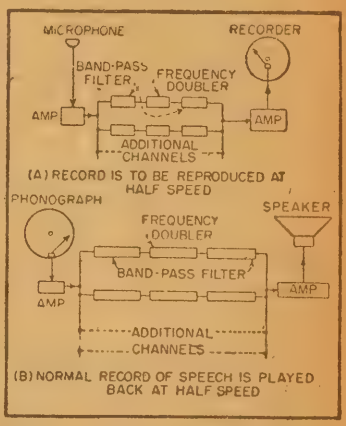
If the input consisted of a whole series of simple tones, they would penetrate the respective filters and emerge in combination at the output, each tone having been raised in pitch by one octave.

In practice, the human voice is far more complex than a simple series of tones and difficulties are encountered with phase angle, sum and difference products, transient sounds, &c., each of which impose differing requirements on the filter design. There is a practical limit also on the number of channels which can be employed.

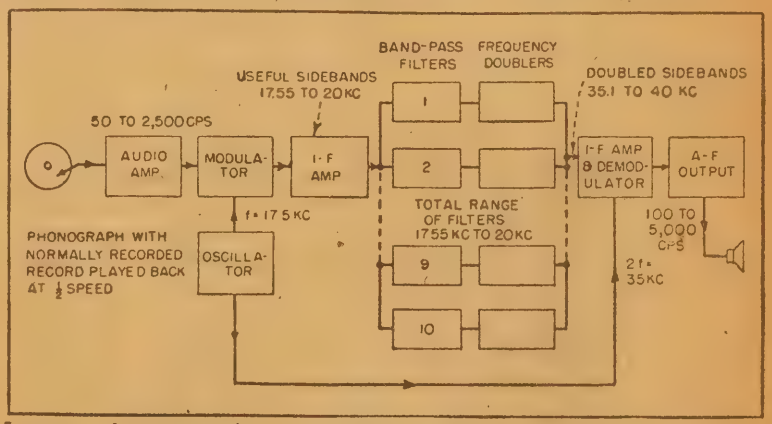
The resulting instrument is likely to be a compromise which does effectively double the time scale but which still leaves the impression of a somewhat lowered pitch. The pitch reduction, however, is not sufficient to cause any serious loss on intelligibility.

The result can be described as if the person were speaking very slowly and deliberately and with a "southern" drawl.

An alternative and preferred approach to the whole problem involves beating the whole of the half-speed output signal with a supersonic "carrier," selecting and doubling the upper sideband frequencies with RF circuitry, then "demodulating" the result with the same supersonic carrier ("Electronics.")



Illustrating the audio system for stretched speech.



Sequence of stages in the speech stretcher using RF circuitry and components. Although more complicated at first glance, it is a better proposition for manufacture.

STANDARD -FERGUSON- RANGE

For Output Transformers see other ad in this issue.

RECEIVER POWER TRANSFORMERS

CODE No.	PRIMARY VOLTS	HTV aside	HT mA	FILAMENTS	RETAIL PRICE
PF185	240	150	30	6.3V/2A	53/9
PF299	240	285	40	6.3V/2A, 5V/2A	53/9
PF300	240	325	40	6.3V/2A, 5V/2A	55/8
PF201	240	225	50	6.3V/2A	54/10
PF151	200, 230, 240	285	60	6.3V/2A, 5V/2A	65/-
PF166	200, 230, 240	325	60	6.3V/2A, 5V/2A	66/1
PF165	200, 230, 240	385	60	6.3V/2A, 5V/2A	71/3
PF170	200, 230, 240	285	80	6.3V/2A, 6.3V/2A, 5V/2A	78/9
PF169	200, 230, 240	325	80	6.3V/2A, 6.3V/2A, 5V/2A	80/-
PF168	200, 230, 240	385	80	6.3V/2A, 6.3V/2A, 5V/2A	74/5
PF130	200, 230, 240	285	100	6.3VCT/2A, 6.3V/2A, 5V/2A	84/5
PF164	200, 230, 240	325	100	6.3VCT/2A, 6.3V/2A, 5V/2A	84/5
PF160	200, 230, 240	385	100	6.3VCT/2.5A, 6.3V/2A, 5V/2A	93/7
PF152	200, 230, 240	285	125	6.3VCT/3A, 6.3V/2A, 5V/2A	104/7
PF163	200, 230, 240	325	125	6.3VCT/2.5A, 6.3V/2A, 5V/2A	106/3
PF181	200, 230, 240	385	125	6.3VCT/3A, 6.3V/3A, 5V/2A	116/11
PF174	200, 230, 240	285	150	6.3VCT/2A, 6.3V/2A, 5V/2A	109/10
PF142	200, 230, 240	325	150	6.3VCT/2A, 6.3V/2A, 5V/3A	118/2
PF175	200, 230, 240	385	150	6.3VCT/2A, 6.3V/2A, 5V/3A	136/11
PF173	200,230, 240	425	175	6.3VCT/3A, 6.3V/2A, 5V/3A	231/11
PF140	200, 230, 240	385	200	6.3VCT/3A, 6.3V/3A, 5V/3A	198/2
PF171	200, 230, 240	385	250	6.3VCT/4A, 6.3V/3A, 5V/3A	261/3

POWER AMP. AND LOW POWER TRANSMITTER UNITS

PF159	220, 240, 260	475	175	6.3V/4A, 6.3V/2A, 5V/3A	231/1
PF172	200, 230, 240	500	200	6.3V/4A, 6.3V/3A, 5V/3A	261/3
PF143	200, 230, 240	600 500	200	2.5V/5A, 2.5V/5A, 5.5V/.5A	288/9
PF147	200, 230 240, 260	1000 750 500	200 250 300	5.5V/.3A	357/6
PF179	200, 230, 240	475	225	6.3V/CT/4A, 6.3V/2A, 5.5V/3A	225/7
PF107	230, 240	585	250	6.3V/3A, 6.3V/2.5A, 5V/3A	275/-
PF176	200, 230, 240, 260	1250	300	6V/.3A	550/-
PF177	200, 230, 240, 260	1830, 1100	300	6V/.3A	Price on request

VIBRATOR AND AC POWER TRANSFORMERS

PF182	240AC 12VIB	200	40	12.6V/1A	65/10
PF122	240AC 6VIB	220	40	6.3V/2A	66/1
PF125	240AC 6VIB	250	60	6.3V/2A	77/1
PF126	240AC 12VIB	250	60	12.6VCT/1A	77/1
PF119	240AC 6VIB	325	125	6.3V/4A	109/7
PF146	200, 230, 240 AC, 12V, VIB	325	150	12.6VCT/2.5A	129/5

VIBRATOR TRANSFORMERS

CODE NR	PRIM. VOLTS	DC OUTPUT VOLTS	mA	BUFFER Full Sec.		RETAIL PRICE
VT100	32	200	40	.005		58/-
VT101	6	90	15	.008		45/6
VT102	6	150	25	.005		53/1
VT103	6	200	50	.005		56/-
VT104	6	250	60	.005		57/4
VT105	12	250	60	.005		59/4
VT106	6	300	75	.008		94/8
VT107	6	250	60	.005	Low Radiation	62/8
VT108	12	90	15	.008		47/4
VT109	24	90	15	.008		50/-
VT110	12	150	25	.005		56/-
VT111	24	150	25	.005		61/4
VT112	12	200	50	.005		58/8
VT113	24	200	50	.005		58/8
VT114	12	300	75	.008		102/-
VT115	24	300	75	.008		103/4
VT116	24	250	60	.005		65/4
VT117	12	250	60	.005	Low Radiation	63/4
VT119	32	150	25	.005		53/-
VT121	6	180	30	.005		58/8
VT122	6	400	50	.005		96/-
VT123	12	320	125	.005		92/6
VT124	32	250	60	.005		64/-
VT127	6	200	50	.005	Low Radiation	58/8
VT128	12	250	60	.005	Low Radiation	69/4
VT146	6 or12	240AC	50W	.05	For emergency light, etc.	86/8

POWER CHOKES

CODE No.	IND. HY.	DC RES	DC mA	RETAIL PRICE
CF100	50	1900	10	38/5
CF101	30	870	25	37/9
CF102	15	300	60	29/4
CF103	30	420	60	55/1
CF104	30	580	75	58/5
CF105	15	250	80	49/1
CF106	12	200	100	50/-
CF107	30	360	100	67/9
CF108	12	135	150	70/5
CF109	20	225	150	73/4
CF110	12	100	200	85/4
CF111	16	165	200	85/4
CF112	10	70	250	85/4
CF113	.5/20	70	250 50	93/6
CF114	1.1	23	375 AC	49/6
CF115	.017	.6	2A	25/9

GRID INPUT TRANSFORMERS

CODE NR	MATCHING FROM	TO	NOM. IMPEDANCE PRIM.	SEC.	MAX. WATTS	RETAIL PRICE
MT104	Mike, P.U.	Grid	3.7, 50	50,000		58/5
MT105	Mike, P.U.	Grid	3.7, 50	60,000		214/5
MT108	Line	Grid	120	1200		129/4
MT109	Cath.	Grid	100	1000		73/4

LINE TRANSFORMERS

MT100	Line	Spkr.	600	4, 3	15	73/4
MT101	Line	Spkr.	500	15	15	73/4
MT124	Line	Spkr.	600 500	4, 3, 2.7 2.3, 2.	25	123/4
MT125	Line	Spkr.	600 500	15, 12.5 8.4, 6.5	25	120/3
MT111	Line	Spkr.	500	12.5, 8 2.3	10	78/10

MODULATION TRANSFORMERS

MT118	Audio Amp	Class C Amp	8000 6000 P.P.	10,000 7000 5000	25	193/4
MT119	Audio Amp	Class C Amp	8000 6600 3800 P.P.	10,000 7500 6500 5500 4500 3500	50	222/10
MT120	Audio Amp	Class C Amp	500 to 20,000 in steps	500 to 30,000 in steps	50	408/
MT121	Audio Amp	Class C Amp	500 to 20,000 in steps	500 to 30,000 in steps	125	514/8

DRIVER TRANSFORMERS

MT106	Class A Driver S.E.	Class ABI Grids	5000 Step Up 1:5 Pri. DC 40 mA	125,000	5	127/9
MT107	Class A Driver HI. MU. S.E.	Class A Grids P.P. or S.E.	10,000 Step Up 1:3	90,000	1	186/5
MT112	Class A Driver HI. MU S.E.	Class A Grid P.P. or S.E.	10,000 Step Up 1:2 5 mA DC unbalance	40,000	.5	117/4
MT113	Class A Driver S.E.	Class AB2 Grids	5000 Step Down 1.25:1 40 mA Pri. Dc	3200	2	139/6
MT114	Class A Driver P.P.	Class B Grids	5000 Step Down 1, 1.5 or2	5000 2200 1250	5	159/9
MT115	Class A Driver P.P. or S.E.	Class B Grids	5000 Step Down 1.07 or 1.4 40mA DC max unb.	4400 2500	5	159/9

FILAMENT TRANSFORMERS

CODE No.	PRIM. VOLTS	SEC. VOLTS	RETAIL PRICE
PF117	240	2.5V/3A.	38/-
PF118	220, 240, 260	2.5V/5A, 2.5V/5A.	66/5
PF158	220, 240, 260	5V/8A.	73/4
PF138	220, 240	6.3V/4A, 5V/4A, 2.5V/4A, 2.5V/4A.	104/-
PF162	240	6.3V/3A, 6.3V/3A.	76/5
PF154	200, 230, 240	7V tap 6V/7A, 6.3V/3A, 5VCT/5A, 5V/3A, 2.5V/7A.	220/-
PF102	240	7.5V/2A.	55/9
PF111	240	10V/5A.	78/10
PF131	230, 240	10VCT/10A, 5V/15A.	234/8

ENGINEERED **TO-DAY** FOR **TO-MORROW'S** REQUIREMENTS

NEWS AND VIEWS OF THE MONTH

Silent Key

WE learned with the deepest regret of the death on May 16 of W. G. Ryan, VK2TI, past president of the NSW division of the Wireless Institute of Australia, and well known in amateur radio circles all over the world.

Wal Ryan had been active in institute affairs for more than 10 years, since 1935. A secretary and later president of the division, he was largely responsible for building the institute in this State, and for holding it together during the war period when licences were suspended, and many amateurs were in the Services.

During the war he was the mainspring of the National Emergency Radio Service organised in the amateur movement, and at the termination of hostilities, was commended by civilian and service authorities for his work.

More recently, as chairman of the Federal Contest Committee of the institute, he did most of the organising for the VK-ZL-DX contest, which last year was held as portion of the Commonwealth Juiblee celebrations. In this he did an outstanding job in helping to publicise Australia to the world.

It was a mystery, even to his close friends, how Wal ever found time to do so much work for amateur radio, and at the same time lead such an active life on the air. He figured in many contests as a competitor and won places in several. Even when he retired from the local council, his wide experience and foresight was of great assistance to those who succeeded him.

In the history of amateur radio in Australia, VK2TI will hold an honored place, and all will remember him with affection and esteem.

* * *

Aid For Deaf-Blind

THE first public demonstration of a new "conversation" machine invented for communicating with the deaf-blind took place in London recently.

The machine looks like a portable typewriter with a fixed metal plate in place of carriage and moving typearms.

The sighted person taps out his message on the letter keys while the deaf-blind person facing him keeps his fingers on six rising studs in the metal plate.

When any one of the letter keys is depressed by the sighted person it automatically forces up various combinations of these six studs under the fingers of his deaf-blind correspondent to form one or other of the letters of the Braille alphabet.

The machine, too, can be easily adapted for the use of a number of deaf-blind persons by plugging it in to the master unit of a number of individual receivers.

Thus the message being tapped out on the keyboard of the master instrument is translated into Braille on a number of receivers simultaneously.

Since few blind persons can read Braille at more than 15 words a minute, typing inexperience on the part of the sighted person is no bar to the instrument's use.

The machine was designed by Mr Andrew R. Cooper, who is the Divisional Controller of the Merseyside and North Wales Division of the British Electricity Authority, Britain's nationalised electric power and light industry.

Master units similar to the prototype already made are likely to cost £50 each, whilst repeater units would be about £20 each. If many of the instruments are manufactured the price would, of course, be less.

* * *

Flying Saucers

IT seems almost impossible to entirely discount reports of flying saucers which have lately re-appeared in the local Press. The name appears

POPULAR SCIENCE QUIZ

How many questions can you answer, arising from the scientific film "Destination Moon"?

How far from the Earth is the Moon?
Approximately 238,000 miles.

What are the problems of eating in a space ship?
Since gravity is not effective, it is difficult even for a person to swallow and food has a way of simply floating off into space.

In which direction is it easier to travel? Why?
From Moon to Earth. There is less retardation by gravitational pull.

Approximately how much would an average person weigh when on the Moon?
25 pounds. The force of gravity is only 1-6th that of the Earth.

Is there any military value in efforts to reach the Moon?
Military experts claim that the nation which controls the Moon, controls the Earth.

In the film "Destination Moon," individuals carried radio for communication between themselves. What is the inference?
No sound can be heard at all on the Moon because there is no air to carry it.

In this same film, why did the occupants of the rocket ship lay in couches during the take-off.
If in a sitting position, they would immediately "black-out" because of the rocket's rapid acceleration, or faint from partial anemia caused by blood being drawn away from the brain.

Which is larger, the Earth or the Moon?
The Earth. Its diameter is about four times that of the Moon.

Does the Earth revolve around the Moon, or the Moon around the Earth.
They revolve around a common centre of gravity, about 1000 miles below the surface of the Earth.

Is there any life on the Moon?
There is apparently no living thing, no plant, animal, water or air on the Moon. It is completely desolate.

Is a trip to the Moon possible?
Yes, not only possible but inevitable. For military reasons, it may develop into an international race.

How soon will a trip to the Moon actually be made?
According to some authorities even within the next 10 to 15 years.

How long will it take a rocket ship to make the trip to the Moon?
In the film "Destination Moon" the trip is made in 45 hours.

How can power for a rocket ship's trip to the Moon be generated?
By the application of atomic heat on a reaction mass. This mass was water in the film mentioned.

What does science already know about the Moon as a military base?
It is known that V-2 rocket, as we know it today, fired from the Moon could reach the Earth with ease.

Why are scientists interested in reaching the Moon?
Besides military reasons, to make scientific recordings of the Universe never before possible and to search for uranium and other strategic minerals.

Is there a natural landing place on the Moon for a rocket ship from the Earth?
Yes, the crater Harpalus, as shown in "Destination Moon."

Why is the crater, Harpalus, the choice for a landing field on the Moon?
Because the crater affords some shade at all times of day for protection from the Sun's unfiltered rays and intense heat.

Can the Moon's crater, Harpalus, be seen from the Earth?
Yes. Views of the crater, as shown in the film, were based on pictures taken at Mt. Wilson Observatory (USA).

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When you buy a Rola Isocore Transformer you buy *Reliability*, the product of sound design, top grade materials, and manufacturing know-how.

Every type of Rola transformer is tailored to its job. For your own protection use coded Rola Isocore transformers; they'll do the job better and longer. Standard types are listed below.

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1D4, 1L5	15,000		CB892, DCL46, GBL59
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2A5, EL3, 6M5	7,000		CBG64, DBG96, GCG72
2A5, 6V6, KT61	10,000 c.t.	BOL109,	COLS3
6V6, 25A6	5,000		CBG81, DCG87, GDG68

...type 17/5d.

to be somewhat misleading today. Many of the reported object apparently bore little resemblance to a saucer, although a saucer-shaped object might resemble the often-reported "cigar" shape if viewed end-on from a distance.

It seems almost incredible that there is no foundation for such reports, many of them coming from experienced pilots and flying men, all of whom could hardly be suffering from hallucinations or self-hypnosis.

On the other hand, any psychologist can detect clearly the traces of carefully-handled tactics in official reaction to the reports. One can be pardoned for concluding that objects of some kind were definitely seen by some watchers, and that officialdom, in its willingness either to encourage fantastic theories, or its blunt refusal to comment, is really indicating that it knows something, or worse still, knows nothing.

The net result is that the public just doesn't worry unduly about "saucers," realising that whatever the implications, the whole subject is beyond its ken, and best left to scientists to argue, or fiction writers to exploit.

One thing is certain—that if there are in fact flying machines able to cover vast distances, and to speed through the atmosphere and the stratosphere almost at will, they are forerunners of something which sooner or later must affect us all. One presumes that they do not come from another planet, and therefore they must depart and return to some place on the earth. Nor is it reasonable to suggest that they are being used merely for somebody's entertainment. They can't all be US naval balloons, as was reported some time ago in explanation of the various sightings made from time to time in that country.

All we can say at this stage is that we sincerely hope they are "ours" and not "theirs," whoever "they" might be.

* * *

New Stations

A BROADCASTING Control Board plan provides for 20 new national stations in Australia.

The board's plan will ensure better radio reception throughout Australia.

It will give New South Wales seven new stations and will increase the power of seven existing stations.

Bega, Glen Innes and Smithtown will get new regional stations.

Armidale, Canberra, Murwillumbah and Wollongong will get new low power stations.

Stations 2BL and 2FC, Sydney, 2CR Cumnock and 2NR Grafton will get power increases to 50,000 watts.

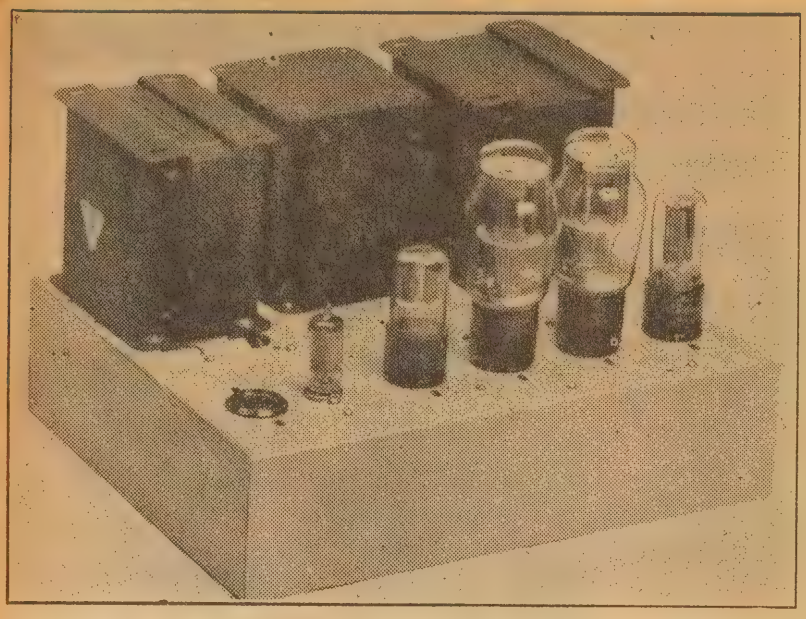
Stations 2NA and 2NC, Newcastle, and 2CO Corowa will get power increases to 10,000 watts.

The board believes that unless the power of some Australian stations is increased high power transmitters in other Pacific countries may distort the reception of Australian listeners.

Pacific area countries plan 24 stations of 100,000 watts or more.

The board also has decided that it will be necessary to establish some new commercial broadcasting stations and to increase the power of others.

At June 30, 1951, 982 applicants wanted to establish new commercial stations.



The 2A3 Playmaster looks very much the same as previous models except for the 2A3's. Sockets, left to right, are—input from control unit, 6AU6, 6SN7-GT, 2-2A3 and 5Y3-GT.

'PLAYMASTER' AMPLIFIER No. 5

A fine amplifier of approximately 10 watts output designed for triode valves of the 2A3 class. It should be the answer for those who are insistent on triode output valves, and for those who would like to rebuild 2A3 amplifiers so that the Playmaster tuners and control units can be used with them. The performance of this amplifier is exceptionally good.

by John Moyle

IN setting out to design the Playmaster series, we made the point that it is somewhat futile to chase distortion figures of fractional percentages if at the same time we introduce circuits too costly or critical to use, particularly when such low distortion is completely swamped out by much larger contributions from pick-up, records, and loudspeaker.

It is true that the distortion figures of all the Playmaster amplifiers, particularly the push-pull jobs, would in fact be well below one pc at normal operating levels, and not much worse at full output. What is much more important is that, despite the very large numbers which have been built, we have not heard of one reader who has failed to get the results he expected, or who has been plagued by motorboating, oscillation, high hum level, or other troubles that often go with "super" circuits.

NEW IDEAS?

One or two readers seem to be disappointed that the circuits did not introduce any new hookups. I can't altogether agree with this as criticism. It just happened that the results aimed at were obtained by a combination of standard techniques, and I couldn't see the point in being different for the fun of it.

At any rate, I'm quite satisfied now that our readers can select a combination of units to suit their own requirements in the safe knowledge that they will work together smoothly and without giving any trouble. Let's leave special ideas for the amplifier experimenter. The Playmaster series was intended to define a basis for everyday, high grade equipment to go into use and stay there.

BEAM TUBES

In working out these ideas, we settled on beam power valves used at tetrodes rather than as triodes. This was done because we believed that such amplifiers could be made to the necessary electrical standard more simply and efficiently. We questioned whether any possible improvement in distortion figures or loudspeaker damping could be detected by anyone using the equipment for playing radio and records.

We know, of course, that there are many people who still prefer to use triodes, and they have every right to consider these valves superior in practice if they feel so inclined. It isn't our desire to debate the point in this article, as, in any case, it would more or less boil down to a matter of personal opinion and one's assessment of his own ear. We aren't necessarily making a case for beam valves versus triodes, on purely technical grounds. Its more that we don't see why we should strive for laboratory performance figures when our main object is the clean reproduction of records.

FIRST COST

Cost, too, comes into it. On the basis of a 10-watt amplifier—about the figure of the Playmaster which uses 6V6-GT's — the only triodes obtainable without too much difficulty are the 807 (triode-connected) and the 2A3. The former is ruled right out on the score of expense if nothing else. The valves themselves now cost about £2 each, the power supply is heavy duty, and our main justification for publishing the 807 Playmaster was as a rebuild proposition for Williamson's.

It's a magnificent amplifier, of course, but much more powerful than many people require.

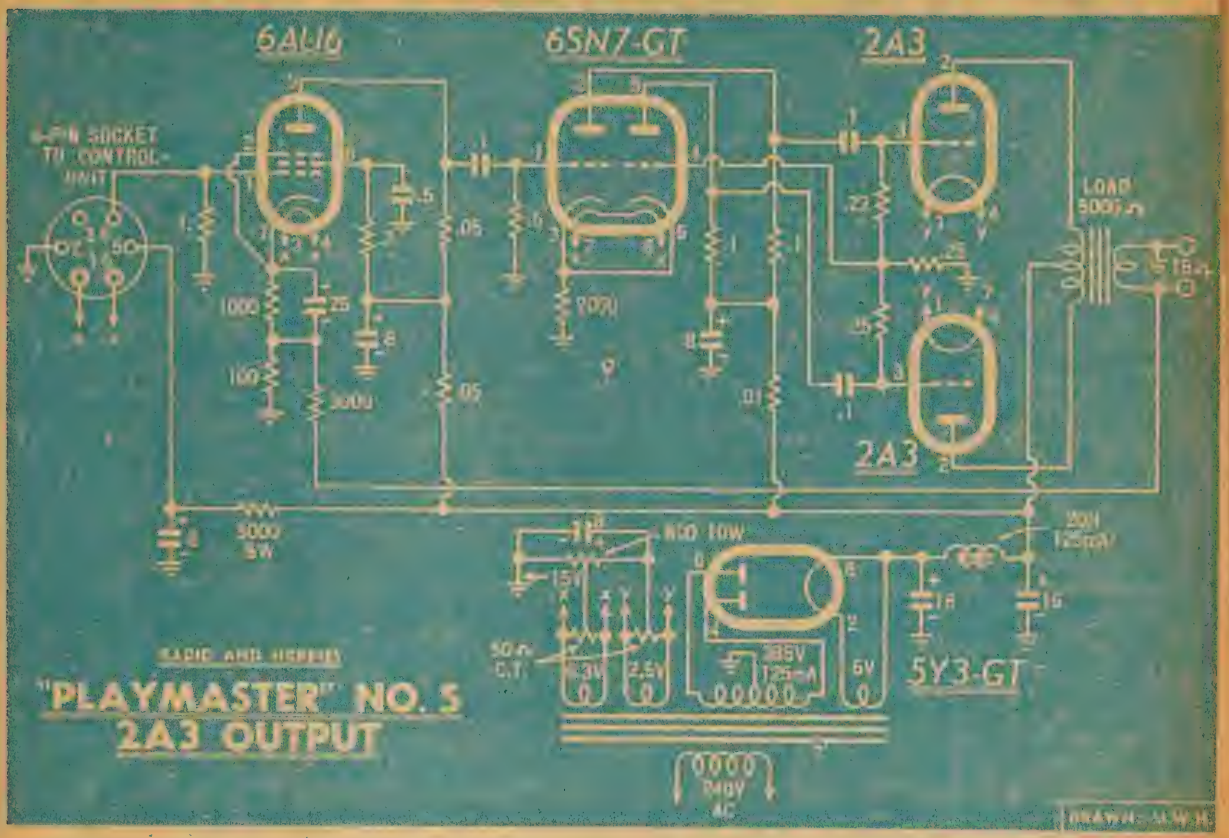
There are no other beam valves suitable for triode connection. The 6V6-GT can be so used, but its power output is far too small. That leaves us with the 2A3-6A3 triodes which can still be obtained in modest numbers.

These valves aren't too costly, and use a power supply of the same rating as for 6V6 Playmaster except for a higher voltage. They will give about 10 watts if properly used, and look a much better proposition.

Don't imagine that because the 2A3 has been with us for some time it's not a good triode. Except for a rather high input voltage rating, it has most things a good output triode needs. It has a very high gm of 5250, and a plate resistance of 800 ohms. This means a very low effective plate impedance, and a good damping factor for the loudspeaker. There are one or two types which can be regarded as an improvement on the 2A3, but they aren't so much ahead for our purpose, and are virtually unobtainable in this country.

With the rating we intend to use the 2A3's operate at class AB1. Over the last portion of their operating cycle they run down somewhat below

CIRCUIT DIAGRAM OF PLAYMASTER AMPLIFIER No. 5



The circuit is quite a simple one. The 2A3 grid resistors (.22 and .25 megs) should, if possible, be 1 pc tolerance. For 8 ohm speakers, change the feedback resistor to 2000 ohms, for 2.3 ohms change to 1000 ohms.

cut-off, but the grids are not driven far enough positive to draw grid current. The plate current is slightly greater at full output than resting, but the push-pull connection allows all these matters to balance out so that nominal distortion at 10 watts output is only 5 pc.

Inverse feedback is used in the amplifier and just on 20 db is applied. This means a reduction of distortion to about .25 pc and at normal levels it would be completely negligible.

At the same time, the output impedance, already low, will almost vanish with this degree of feedback.

PRACTICAL RESULTS

There is no reason why this order of performance should not be realised if the amplifier is built with good components. The distortion produced elsewhere should not materially affect the total. In practice, the amplifier proved to be a really fine one, and on paper is probably the best Playmaster of all. Whether you could pick it in practice is another matter.

So much for our introduction. We have decided to use the 2A3 or 6A3 type of output valve (only the filament volts are different), using a self-bias rating to give an output of about 10 watts. Input sensitivity is to be 350-500 millivolts and feedback of about 20 db is to be aimed at.

The first problem to be tackled was the fact that, with a nominal 62 volts of bias, the 2A3's require about 120 volts to swing them to full output. At the same time, there is a limit of .5 meg. grid resistance in this type of operation.

Transformer coupling is generally used with 2A3's to provide this degree of swing and to provide the lowest possible grid impedance as recommended for these valves. We didn't wish to follow this practice as transformers, even if obtainable, have many disadvantages. They are costly, tend to pick up hum and make the application of inverse feedback a tricky business except on a limited scale.

The alternative is to use a phase changer valve, and chase those 120 volts for the 2A3's.

The simple plate-cathode load phase-changer isn't very good in this circuit because it's quite difficult to get enough output from it.

Using a high applied voltage we would be scraping to obtain even 100 volts, which is far too low.

Such a circuit could be used if the maximum output required does not exceed 6 or 7 watts. This would not mean more than about 5 watts in practice, through losses in the output transformer.

PARTS LIST

1 "Playmaster" chassis (No. 1 or 2)
1 Power transformer 385V a side 125 mA, 6.3V, 2A, 5V 2A, 2.5V 5A.
1 Filter choke, 20H 125 mA.
1 Output transformer 5000 ohms CT to voice coil.
1 7-pin miniature, 2 octal, 2 4-pin, 1 6-pin sockets, 1 speaker plug and socket.

VALVES

2 2A3, 1 6SN7GT, 1 6AU6, 1 5Y3GT

CAPACITORS

1 25 mfd 40PV electrolytic, 2 16 mfd 600PV electros., 4 8 mfd 525PV electros., 1 .5 mfd and 3 .1 mfd 400WV tubular.

RESISTORS (1 watt standard)

1 1 meg., 1 .5 meg., 1 .25 meg., 1 .2 meg., 2 .1 meg., 2 .05 meg., 1 .01 meg., 1 3000 ohms, 1 2000 ohms, 1 1000 ohms, 1 100 ohms.

RESISTORS (1 watt 1 pc)

1 .25 meg., 1 .22 meg.

RESISTORS (wirewound)

1 5000 ohm 5W, 1 800 ohm adjustable 20W, 2 50 ohm CT 3W.

SUNDRIES

Resistor mounting strip—10 sections, 3 3-tag mounting strips, 3-core power flex and 3-pin plug, hook-up wire, solder, lugs, nuts and bolts, &c.

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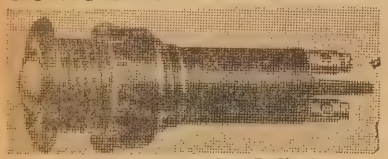

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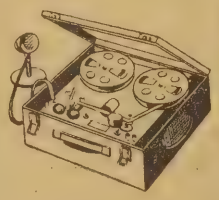

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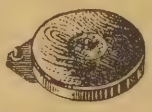

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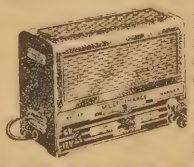

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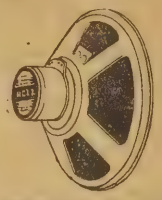

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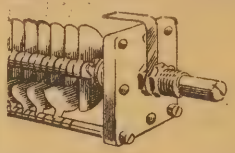

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PLAYMASTER No. 5 SERIES—

WITH PUSH-PULL TRIODE VALVES

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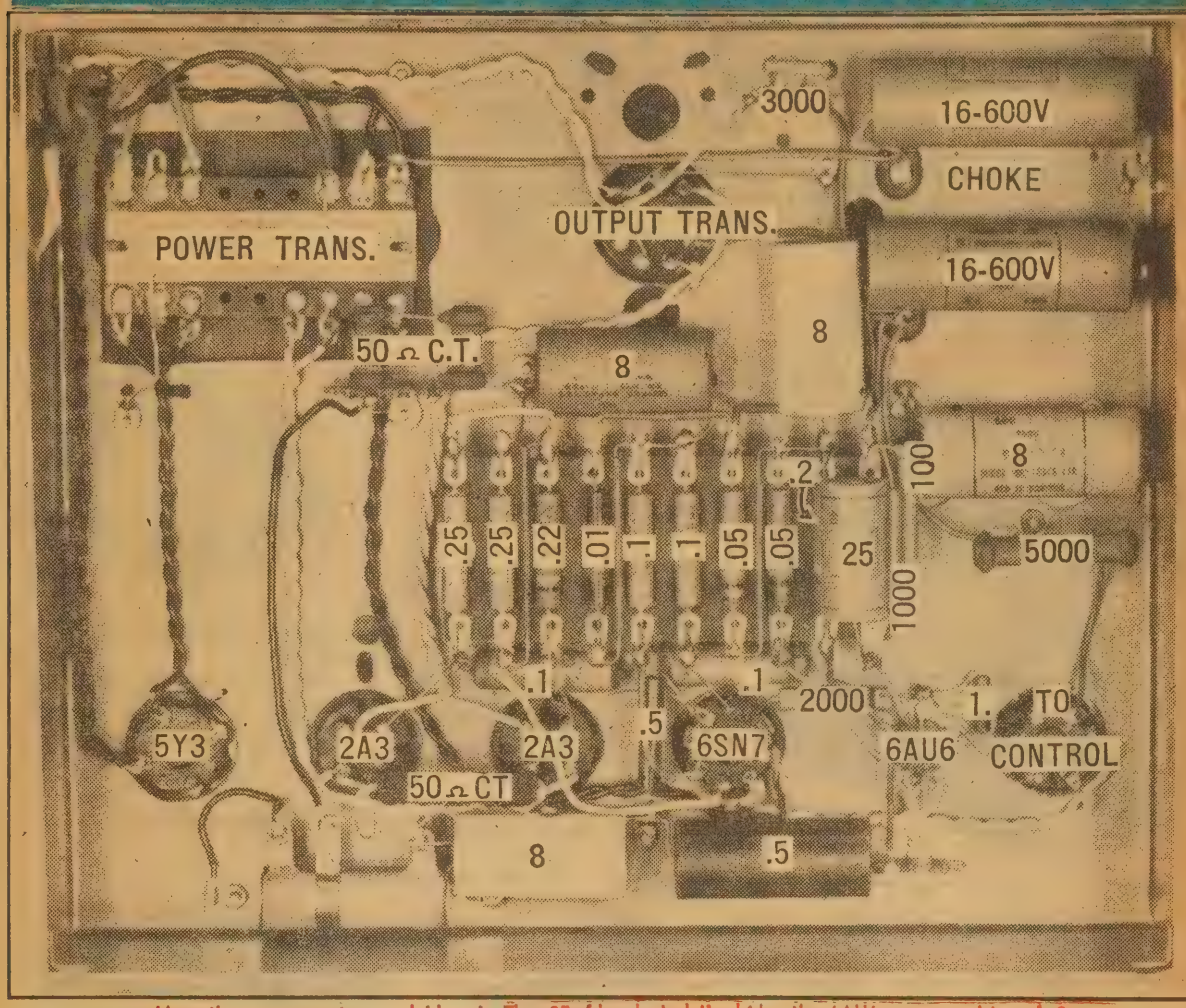
UNDERCHASSIS VIEW OF 2A3 PLAYMASTER AMPLIFIER



How the components are laid out. The 25mfds electrolytic hides the 6AU6 screen resistor of .2 megs

There are some other phase-changer circuits we could enumerate, such as the cathode coupled type, all of which are good, but few of them will give enough output voltage.

The most likely is the paraphase circuit, in which a second triode is driven by picking off the required grid voltage from the output circuit of the first. Although two separate triodes can be used, it is usual to employ a valve of the dual-triode type.

With this circuit the output from both triodes is available for driving the 2A3's, and we can easily arrange for it to be more than sufficient.

TWO SYSTEMS

There are two methods of obtaining the correct voltage and phase for the grid of the second triode. One is to tap the necessary volts from the grid circuit of the first 2A3. This calls for some careful work on individual amplifiers, and is generally abandoned in favor of a self-balancing circuit as used in the new amplifier.

Here it will be seen that the first triode feeds into a 2A3 grid circuit of .22 megs in series with one of .25 megs, which is common to both 2A3's. From the junction of these resistors a connection runs to the grid of the second triode, thus feeding it with correctly phased driving voltage.

This voltage, equal to about half the first triode's output, would horribly overload the second triode, but for the fact that the grid resistor of the second 2A3, which it drives, runs to earth through that common .25 resistor. Thus, the output voltage from the second triode cancels out nearly all its own drive, leaving just enough to keep it working under approximately the same conditions as the first triode. Obviously, it can't completely cancel out its grid volts, but assumes a state of balance which is automatically preserved.

Normally the circuit is shown with three resistors, all of equal value. In this form it can never be exactly balanced, the second triode producing fewer volts than the first by an amount depending on its stage gain. Quite often this unbalance is just ignored.

It can be remedied, however, by reducing the value of the grid resistor for the first 2A3, thus reducing the voltage developed across it to equal the drive on the second 2A3. The correct resistor values were determined by experiment, using a vacuum tube voltmeter to measure the voltage applied to the 2A3 grids. Fortunately, we were able to use reasonably convenient values. The final balance was within about 1 pc.

To make sure of this the two grid resistors should, if possible, be 1 pc tolerance types, which can be obtained to order. Failing this, it should be possible to check over a number of standard 1-watt types until you strike two of the right value.

BALANCE

Unless the amplifier is to be used near its full output, you aren't likely to notice a small unbalance in the output section. Plenty of push-pull resistance coupled amplifiers, using 10 pc tolerance resistors, are unbalanced without their owners ever knowing about it. But it's a good thing on principle to get them as nearly right as you can.

As regards voltage output from the phase-changer valve, reference to the resistance-coupled charts issued by the manufacturers shows that with plate resistors of .1 megs and a following grid resistor of .25 megs, a 6SN7-GT will give an output voltage of 56, with an applied voltage of 300. The particular grid circuit used for the 2A3's limits the effective grid resistance to .25 megs, as there is another resistor of equal value common to both grid circuits, thus

Homecrafts

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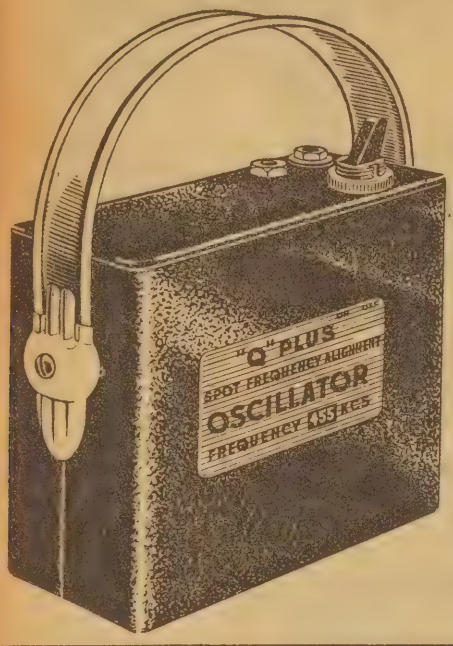

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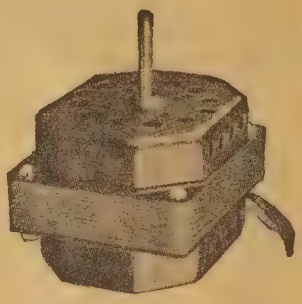

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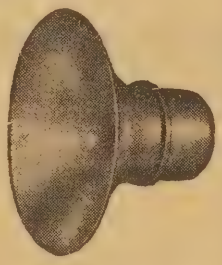

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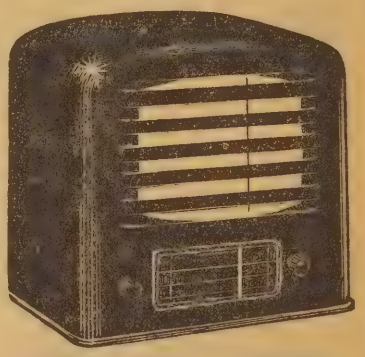

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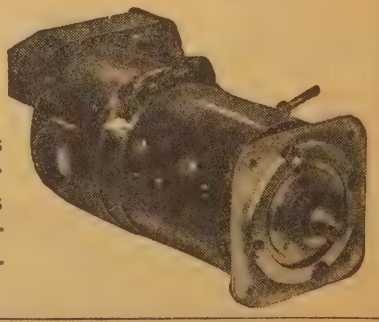

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making up the .5 meg limit imposed by the makers.

There are one or two interesting points about this circuit which won't be discussed here, the main point being that as far as the AC grid load is concerned, it is only .25 megs per valve.

We have, however, more than 300 volts available for the phase-changer, because the total high tension must equal at least 362 volts to allow for biasing the 2A3's. In practice, as we will show later, this voltage will be between 380 and 400. As the output from the valve will be increased in proportion to this extra voltage, we can extract approximately 80 volts per section, or a total driving voltage of 160 for the 2A3's.

MEASURED FIGURE

This voltage was actually measured with a VT voltmeter by running the valve disconnected from its following grid circuits. It can never reach this figure when driving the 2A3's because as soon as these are overdriven they will run into grid current, and the whole thing goes haywire. The point is that we now have plenty of volts to run the output valves right up to their limits.

Coming now to the output valves, we have to find enough voltage to supply them with 300 volts between plates and filaments, which, because of the cathode bias circuit, means a total of 300 plus 62 volts bias. The normal 285 transformer isn't enough and we must therefore use a 350 or 385 volt type.

In practice, we have found such transformers to produce anything between 350 and 400 volts filtered current, according to their design. The type we used ended up with exactly 400 volts total under load from a 385v rating. This meant that the 2A3's were fed with an effective 330 volts on the plates, and nearly 70 volts bias. This latter was due partly to a slightly oversize bias resistor of 800 ohms. The exact resistance quoted is 780 ohms, but we preferred the higher value, particularly as there is a well-known make rated at 800 ohms and 10 watts, with a tap to which we can attach the 6.3 volt filament circuits.

PLATE CURRENT

With this voltage, the two valves draw just 90 mills. mithout signal, which works out at a plate dissipation of approximately 15 watts per valve. As this is the maximum figure quoted by the makers, we haven't any hesitation in using the valves this way, despite the fact that the highest specified operating condition allows for only 300 volts. The 2A3 is a very robust valve, and should give quite satisfactory service at the higher rating.

We would not advise using a transformer which gives a higher voltage than this, although it is most unlikely that you will be faced with the possibility.

The bias resistor is bypassed by an 8 mfds. electrolytic to avoid any possibility of reduced maximum output due to unbalance in plate current. The tapping is placed to supply about 15 volts positive, to which point is connected the centre-tap of a resistor wired across the 6.3 filament circuit. Because the input socket of the amplifier carries the filament supply as well as the grid connection, we have found in some cases a tendency for

(Continued on Page 87)

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Yes, we can supply complete kits of highest quality parts for all of the well known "Radio and Hobbies" Playmaster series Amplifiers, Control units and tuners. This range has been specially designed to provide high quality amplifiers with compensation for all types of records including long-playing microgroove. Amplifier No. 4 is complete on one chassis, but Nos. 1, 2 and 3 are basic Amplifiers intended for use with the separate control units.

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Amplifier No. 1 (R. & H. Oct. 1951) 18W output.
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Amplifier No. 4 (R. & H. Dec. 1951) 4W output.
Control Unit No. 1 (R. & H. Oct. 1951) for use with amplifiers 1, 2, 3.
Control Unit No. 2 (R. & H. Dec. 1951). This is a more elaborate unit than the No. 1 and provides extra bass and treble controls.
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You are invited to send for our free catalogue and price list detailing the above.

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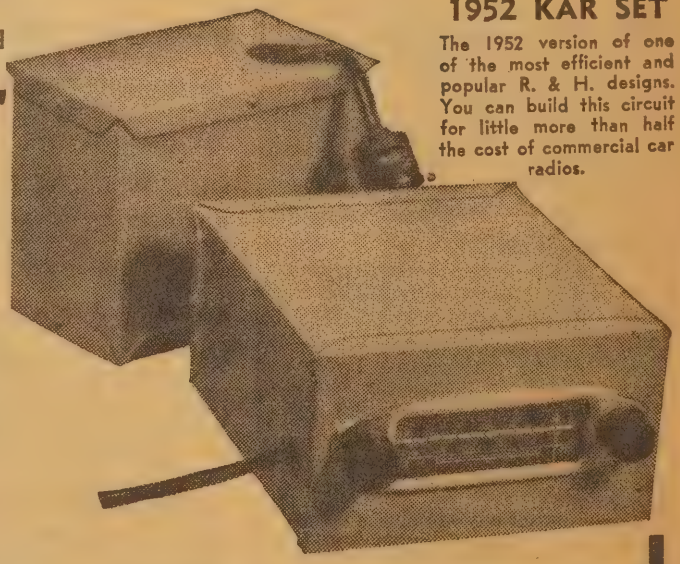
The 1952 version of one of the most efficient and popular R. & H. designs. You can build this circuit for little more than half the cost of commercial car radios.



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A COURSE IN TELEVISION

PART 37—AN INTRODUCTION TO COLOR TV

Most treatments of color television tend to gloss over the characteristics of color and the nature of the stimuli it imparts to the eye. While these matters are not essential to an understanding of actual techniques, the reader is often left wondering at apparent discrepancies between television and other methods of color presentation. This and a succeeding article aims to cover this ground for those who care to study it in detail.

IT can be assumed that most readers are already familiar with the nature of light rays.

In brief, light rays are electrical radiations having an extremely short wavelength between about 16-millionths of an inch to 32-millionths of an inch. More conveniently, the wavelength can be defined as lying between the limits of 400 and 800 millimicrons.

Light rays themselves are pure electrical radiations and are not in any sense "colored." However, when the rays penetrate the normal eye mechanism, they do stimulate sensations, depending on their wavelength, which the observer describes as color.

COLOR SENSATION

Thus, radiations of the longer wavelengths produce the sensation of red, which passes gradually, with reducing wavelength, through to orange - yellow - green - blue - violet. This range of hues, together with those intermediate between them, constitute what are known as the "spectral" colors.

Combinations of red from one end of the spectrum with blue-violet from the other end, produce the non-spectral colors from deep red, through magenta, purple and violet to deep blue.

So-called "white" light contains rays of all wavelengths, while "black" indicates the absence of visible rays.

Any color which can be plotted as a sharply defined curve of response against wavelength is said to be approaching "saturation" — or purity of spectral response.

Colors may be "diluted" with white rays to produce pastel shades, while low-light intensities or pigments darkened with black produce brown, olive green, navy blue, &c.

These are general statements and cover all aspects of color reproduction, ranging from the artist with his palette and the printer with his inks, to the photographer, the projectionist and the television engineer.

Each one has his problems of technique, but the ultimate objective is the same — to present to the eye something which it sees as an acceptable color reproduction.

An ordinary outdoor scene may well contain an almost infinite variety of color values ranging from deep violet right through the visible spectrum, to deep red. Some of the hues may be readily defined as well-known colors, others a complex mixture of two or more such colors.

When such a scene is to be reproduced by artificial means — by artist, photographer or television engineer —the difficulty immediately arises of reproducing the full range of color values without employing a prohibitive range of pigments, dyes, filters or colored phosphors — whatever the medium happens to be.

Many factors arise, in practice, to complicate the choice and the mixing of basic colors, but, by and large, the more such colors available to the operator for mixing, the more closely will the reproduction follow the original.

At the same time, on a commercial basis, each new constituent color

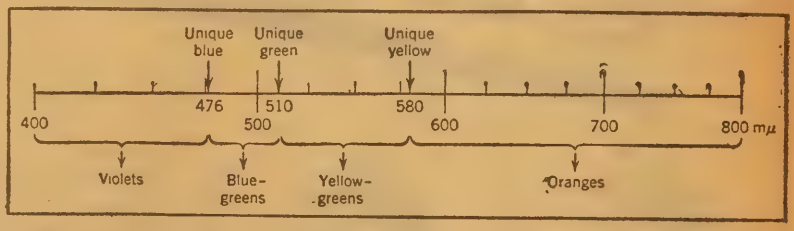


Figure 1: Showing the relationship between color and wavelength in millimicrons. Pure, deep red does not appear, being allegedly beyond the range of normal vision. Most deep reds and magenta are mixtures of red with blue-violet.

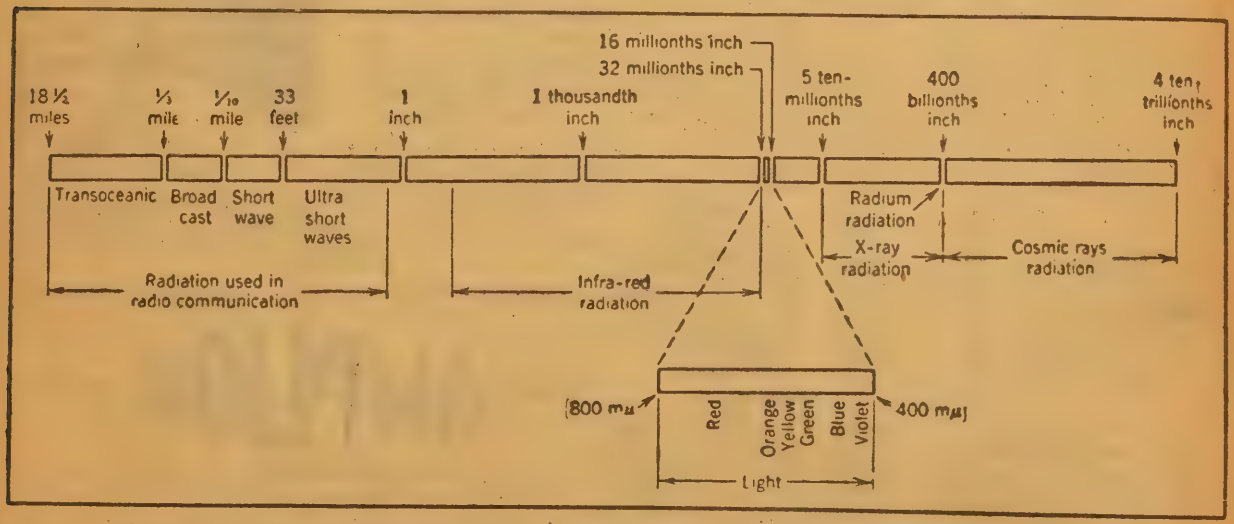
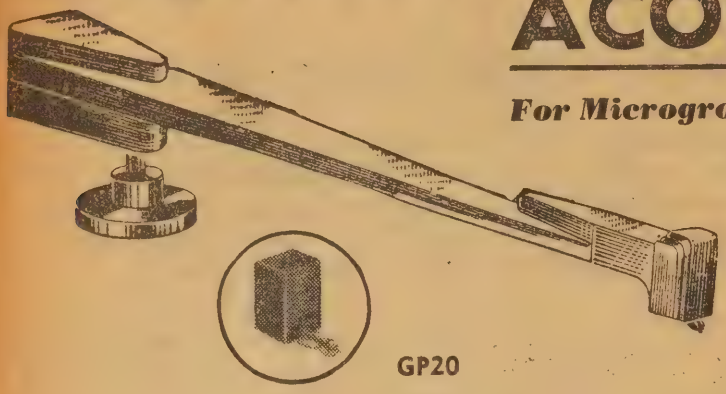


Figure 2: Showing the position and expanse of the visible spectrum in the known range of electro-magnetic radiations. Figure 1, above, shows the visible spectrum on an enlarged scale. (From "Foundations of Psychology.")

The Finest Pick-up Available

ACOS G.P. 20

For Microgroove and Standard Recordings



GP20

Inset: The long-playing head. (GP-19LP) interchangeable with Standard Head (GP-19).

GP9 Cartridge to fit GP10 pickup .. Price **36/9**

GP20

The GP20 pick-up is designed for use with the standard 78 rpm records or the 33 1-3 or 45 rpm long-playing microgroove records. To meet these differing requirements, two interchangeable slide-on heads are available

GP19 head supplied as standard.

GP19 L.P. head available for microgroove. It is something new in pick-up design and has 20 times greater output than comparable magnetic types, while needle talk and motor rumble are practically non-existent — permanent sapphire stylus — wide frequency response.

PRICE .. GP20, complete with standard head £6/3/6

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ACOS MICROPHONES and MIKE INSERTS

MIC 3

MIC3 Diaphragm-actuated Crystal microphone specially designed for the reproduction of speech frequencies. With rising response from 1000 c/s, this microphone has exceptional sensitivity.
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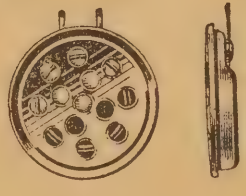

MIC 14

MIC14 Standard Speech Microphone itself with nickel-plate brass case which gives high corosion resistance, mechanical strength and rigidity.
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MIC 18

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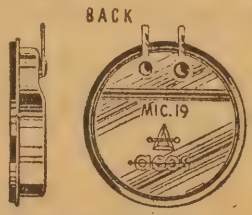

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MIC19/2 Sintercel fulfils the requirement for a flat insert with good sensitivity and a frequency response 40/8000 c/s. Unaffected by vibration, exceptionally robust construction.
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Ideal for . . .
Public Address: High output, light, yet rugged, may be adapted as a lapel mike.
Home Broadcasting: Exceptionally high gain allows direct use into pickup terminals.
Deaf Aids: Used by all leading Deaf-Aid Manufacturers.

Combination Hand-Desk Microphone. Type MIC30

This latest Acos release is a superlative new Microphone designed for use as a hand or desk microphone, and also incorporates a metal loop to permit of hanging it in a convenient position. The microphone is extremely compact and light, weighing only 6½oz and the height is only 7in. At the thickest point it is 2¾in. tapering down to 1 1-8in at the base of the handle.

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means an extra operation and adds to the cost, so that some deliberate compromise is necessary.

The simplest form of color reproduction uses only two basic colors, generally a green-blue and an orange-red.

A two-color print in a magazine thus involves only two printing plates, two shades of ink and a press which prints one color over the other.

By way of further example, two-color motion pictures are sometimes used for advertising purposes. The film, in this case, may have emulsion on both sides. It is so prepared that one emulsion records the color distribution in the orange-red end of the spectrum, the other recording the color distribution at the green-blue end.

After a suitable developing and dyeing process, the two images in combination give an approximate color transparency.

RESULTS POOR

The range of tones which can be simulated with only two constituent colors is very limited and the results, for general use, are poor. True reds and yellows are missing, being interpreted as varying shades of orange. Greens and blues likewise tend to merge into varying densities of the one green-blue base color, omitting the deep, saturated hues.

By using three basic colors, however, instead of two, it is possible to obtain a range of color values which is generally accepted as adequate for commercial presentation.

The three-color system is justified further in principle also by the yet unproven theory that the eye itself has three groups of retinal receptors which are respectively sensitive to radiations at either end and the centre of the visible spectrum.

By using three similar color sources for the reproduction of a scene, it would seemingly be possible to approximate the eye's range of color vision.

Without debating this idea further, it is sufficient to say that the three-color system of analysis and reproduction has been adopted as standard for color photography, colour moving pictures — and for television. Color printing has its own special facilities and problems.

While considerable latitude is possible in choosing sets of three basic colors, the international standard now adopted specifies the wavelengths as follows:—

700 millimicrons—red, but with a slight yellowish tinge.

546.1 millimicrons — green, also with a slight yellowish tinge.

435.8 millimicrons—blue, with a slight reddish tinge.

STANDARD FILTERS

Standardised filters are available which show maximum transmission at these wavelengths or exhibit, for alternative methods of analysis, a maximum degree of opacity. It is thus possible to speak, for example of a "red" filter or a "minus red" filter.

Whatever the system involved, however—photochemical or photoelectronic—the filters are always arranged to analyse and record from the original scene the overall distribution of the three basic colors, loosely referred to as red, green and blue.

The ultimate objective of the final reproduction is likewise to present

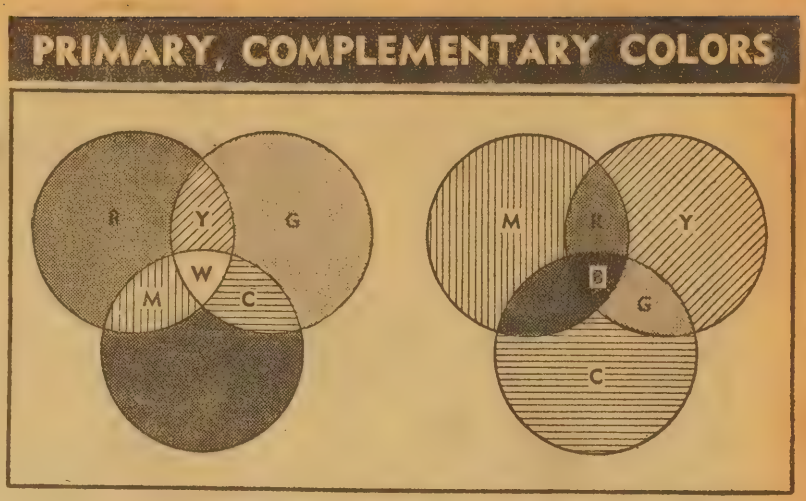

Figure 3: Illustrating, on the left, the fundamental additive primaries and the colors which result from their additive mixing. Diagram on the right gives the subtractive primaries their respective additions. (Benson, IRE Proc.)

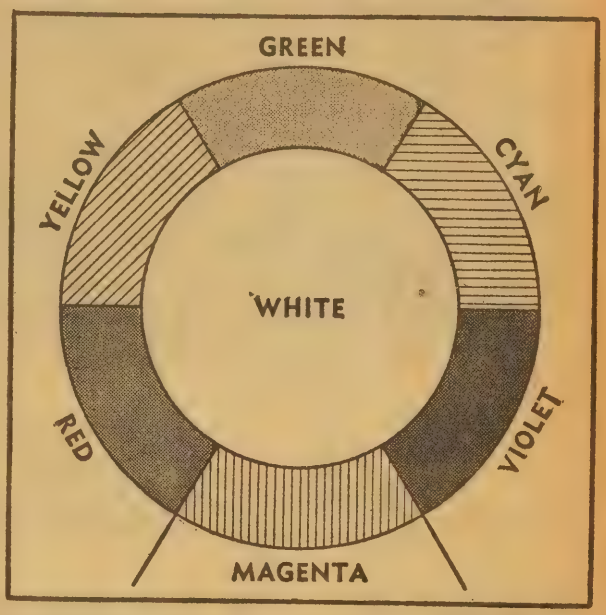

Figure 4: A color circle, showing sequence of primary colors. Note magenta hues between the spectral extremes of red and violet. Opposite colors are complementary or "minus colors" for filter work.

to the eye the same distribution of red, green and blue stimulii, together with all the intermediate and complex hues.

At this juncture much confusion arises because some systems of color REPRODUCTION do not use red, green and blue-violet dyes at all, but another set of colors, which includes a lemon-yellow. Why the difference?

The answer can be provided in one sentence:

Color stimulus registered by the eye can be provided either (1) by a process of light subtraction and mixing in the reproduction itself, or (2) by a summing of color stimulii in the eye.

Behind this statement lies the fact that two distinct methods of color perception exist and the requirements of each in relation to the basic colors in a reproduction differ.

All reproductions are necessarily synthetic, involving a physical mixture of colored pigments, overprinting, stained emulsions on a film, side-by-side color dots, simultaneous projection on to a screen or—in television—a rapidly changing pattern of colored pictures, lines or dots.

In some cases, the light transmitted by—or reflected from—the reproduction has to pass through several layers in sequence of stained emulsions or colored inks. Each absorbs (or subtracts) a particular component of the white viewing light and the eye sees only what is left. Because this residue lies in a particular part of the spectrum, it is registered as a particular color.

Colors which are seen as a result of this process are said to be produced by "subtractive" mixing.

In other processes, the color stimulii are presented to the eye quite independently of one another and their effects add in the eye itself, giving rise to the further term, "additive" mixing.

MIXING PROCESSES

Colors which combine at the eye by "additive" mixing may produce quite a different color sensation from the same two pigment colors combining externally by the subtractive process. It is possible also to have a measure of both additive and subtractive mixing, giving rise to yet another sensation.

By and large, our traditional conception of color values and resultants, based on painting and colored prints, stems from the subtractive principle, and it is interesting to examine this more closely.

An ordinary colored picture, as in a magazine, is illuminated by light

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ON SECOND FLOOR

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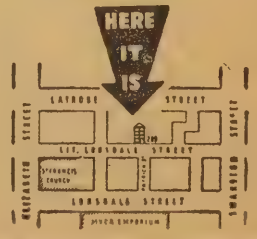
LITTLE LONSDALE STREET



MELBOURNE—VICTORIA

DIAGRAMS OF COLOR MIXTURE

falling on its surface. For proper viewing, the light should be "white," containing components of all wavelengths and therefore of all colors.

The section of the pictures corresponding to the sky would use an ink or a pigment which absorbs most of the red-orange-green rays falling upon it. Rays near the blue end of the spectrum would be reflected back to the eye, however, and the particular section of the picture would appear blue as a result.

Similarly, the pigment depicting red objects would absorb all rays but the red, these being reflected back to the eye.

COMBINATIONS

For green objects—grass, trees, &c. —it has long been established that the desired stimulus can be obtained by mixing together yellow and blue in the desired proportions. The blue absorbs all the red-orange-yellow rays, while the yellow absorbs all the blue-violet. The only rays which are reflected are equivalent to green, and this is the final color stimulus received by the eye.

Used alone, the yellow reflects yellow rays while, in combination with red, the whole range of orange tones is available.

In turn, the red combined with blue covers the whole range of non-spectral colors through deep red to purple, to violet and deep blue.

It is thus obvious why artists, through the centuries, have come to regard red, yellow and blue as primary colors:

(1) Because they could be mixed to simulate all other important colors, and

(2) Because they could not themselves be duplicated by color-mixing.

The fact that they were relying on a subtractive process and that another system of mixing was possible, was largely unknown.

If determined in a precise mathematical basis, the optimum primary colors for subtractive mixing are not just plain red, yellow and blue. The optimum colors are magenta, yellow and cyan-hues which have also been standardised on a world-wide basis.

As a matter of interest, magenta is complementary or opposite to green and, in filter work, a magenta filter is equivalent to minus green. Yellow is minus blue-violet, and cyan is minus red.

SUBTRACTIVE MIXING

For subtractive color-mixing, magenta and yellow together gives tones of red, through to orange.

Yellow and cyan together give tones ranging right through the green region.

Magenta and cyan together give purple, through violet to deep blue tones.

Use of all three colors together give brown, olive green and navy blue. Also, in carefully controlled proportions, a wide range of almost pure greys can be obtained, through to an almost pure black.

While these statements are mathematically accurate, their practical application is complicated by the fact that commercial inks and pigments are seldom pure, exhibiting marked irregularities in their response curves. This leads to secondary color reactions on mixing, so that unexpected hues are likely to result.

In an effort to cancel such unwanted effects, or to emphasise a particular hue, or even simplify a process, the artist or color printer may easily select other than the optimum subtractive primary colors for his essentially subtractive reproduction.

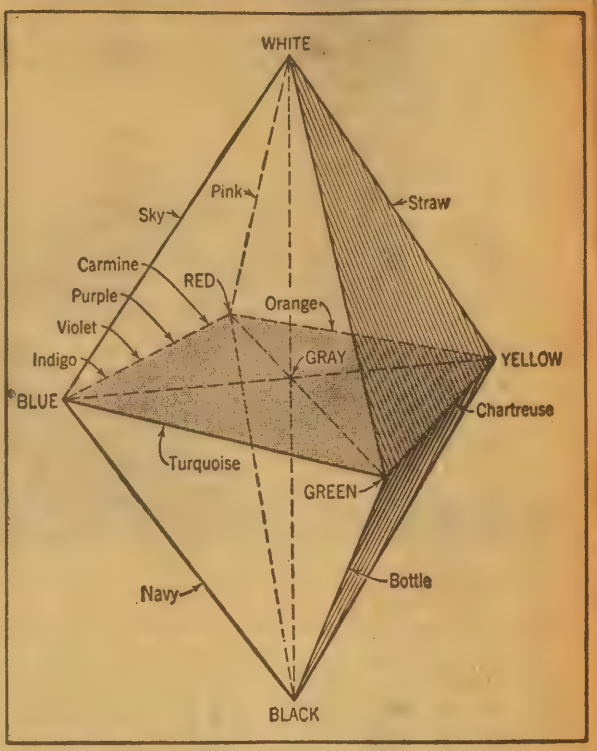


Figure 5. A color pyramid figure, using three dimensions to depict gradations between blue, green, yellow and red. Their adulteration with white produces pastel shades, while black adulteration produces dark shades. Grey is the centre reference point. ("From "Foundations of Psychology.")

☆

What with this and loose terminology, it is easy to see how the fundamental physical primaries — red, green and blue-violet — have been confused with the conventional subtractive primaries of magenta, yellow and cyan. Get the terms right and half the trouble immediately disappears!

Though the main reference has thus far been to colored prints and pictures, the "subtractive" principle is also used to produce certain photographic transparencies, notably Kodachrome. In this case, layers of sensitive emulsion, which are subsequently dyed, subtract the unwanted rays from the white light and transmit the remaining rays to produce the color sensation.

"Technicolor," as used in motion pictures, is likewise a "subtractive" system, though printed by quite a different means.

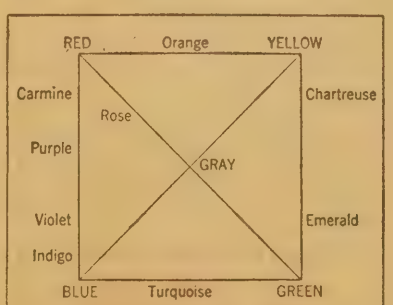


Figure 6: A color square which forms the basis of the double pyramid of figure 5. Note that discreet additive combinations of blue and yellow, also red and green, give grey. Subtractive combination of the colors would give green and brownish tones respectively.

Because Kodachrome, Technicolor and certain other transparencies use the subtractive principle, they must of necessity use the same three primaries in the ultimate reproduction as for color printing. The exact hues may, of course, be modified somewhat by commercial difficulties.

If the reader traces through the Kodachrome principle, for example, it will be found that the red of the original scene is recorded by a red-sensitive emulsion. After development it is presented to the eye as an equivalent red by subtractive combination of magenta and yellow dyes.

SAME PRIMARIES

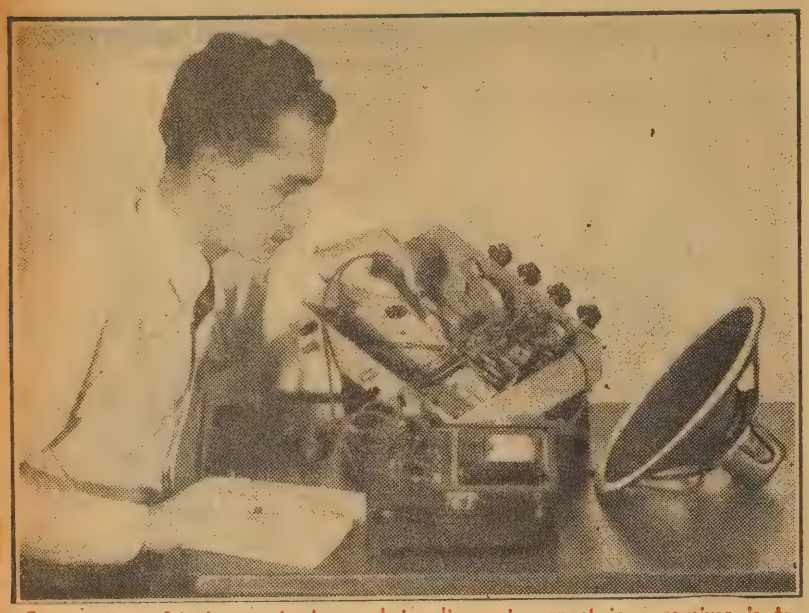
The same is true in sequence for the original green and the original blue-violet in the scene.

In other words, even though the final transparency is prepared with magenta, yellow and cyan dyes, their subtractive combinations and the original analysis of the scene revert to the essential physical primaries of red, green and blue-violet.

The process of color printing involves different intermediate steps but the ultimate result is the same. The red of the original scene is obtained by overprinting magenta and yellow inks. The original green is obtained from yellow and cyan inks, while cyan and magenta reproduce the original blue-violet.

If the subtractive principle were the only method of obtaining the color sensation, the story would end at this juncture and television practice would, in some way, have to follow the principles and standards of color printing. There remains, however, the alternative and completely different approach—that of ADDITIVE color mixing.

This will be discussed in the next issue.



One of the quickest ways to learn what voltages to expect in a receiver is to measure those in typical sets at every opportunity. There is no need to wait for your set to fail before you test it and such readings will provide much valuable experience particularly if they are compared with the recommended figures in the valve data books.

LEARN WHILE YOU BUILD

Having built the multimeter we have been describing over the past few months many readers may be tempted to ask, "Now I have built the thing, how do I use it?" This article is designed to answer this question by describing the checking of a typical 5 valve receiver.

by Philip Watson

THROUGHOUT this series on the construction of the multimeter we have endeavoured to give you some idea of how each section was used, the figures measured on a typical 4 valve set being included to serve as a guide.

This should have served to "break the ice" and give you at least an elementary knowledge of what to expect when testing a set. However, there is rather more to it than that, and most beginners find themselves rather bewildered by some of the variations in readings observed from one set to another.

WHAT VOLTAGES?

Their main question is "How do I know what are the correct voltages to be expected in a particular receiver, and how far can these vary before they effect performance?"

Before those questions can be answered fully we have to consider what type of fault is under consideration.

Faults in radio sets can be classified, very broadly, into two types; one where a set fails to deliver any signals at all and one where it functions but, for one reason or another, the performance is regarded as below standard.

It may be, for example, that the set is weak and will only respond to very strong signals, or that the signals are strong but distorted, or that bad hum ruins the reception, and so on.

The first type, the complete failure, is usually regarded by the experienced serviceman as a "snack," on the simple assumption that any fault which prevents a set from functioning at all must be so drastic as to be almost immediately obvious. In the main this is correct, but note that I said "an experienced serviceman." To the beginner, a completely dead set can often appear as stubborn as an army mule.

The second type can be even more difficult however. Although some of the faults will show up as glaring errors in voltage, there are many which do not affect any of the characteristics which can be measured easily on a meter and which call for more advanced techniques.

Since the complete failure is, relatively, the simpler, let us consider it first.

The question "What voltages can be expected in a typical set?" is something like the old one about "How long is a piece of string?" because the operating conditions can vary over a fairly wide range without effecting the performance of the set to any marked extent.

Thus we find that sets of different design, although intended to do a similar job and probably having similar performance, need not have exactly the same voltage at comparable points throughout their chassis.

While his may appear confusing at first it does serve to drive home one essential point, namely, that the voltages in a receiver are not unduly critical and need to be a long way from normal before they will prevent it from functioning.

VALVE DATA

Some idea of the operating voltages and currents can be obtained from valve data sheets, particularly under the heading of "Typical Operating Conditions" and these valve data sheets should form part of every enthusiast's library. At the same time it must be realised that these are only a guide and it is quite possible for other operating conditions to work quite satisfactory.

It is also possible to make certain general observations on the basis of what is fairly general practice, and this information can be extremely useful, provided it is realised that there are exceptions. One example is the HT voltage, that is, the voltage delivered from the power supply at the last filter condenser. In most modern console sets this is close to the 250-volt mark while, in small mantel sets, it may be anything from 150 to 220.

In a modern set, a transformer of 285 volts will deliver approximately the same DC voltage to the first filter condenser, after which a low resistance filter choke will probably account for 20 to 25 volts, providing a HT of 260 volts. Anything from 6 to 12 volts will be required for bias, giving an effective plate voltage of about 250 or 255.

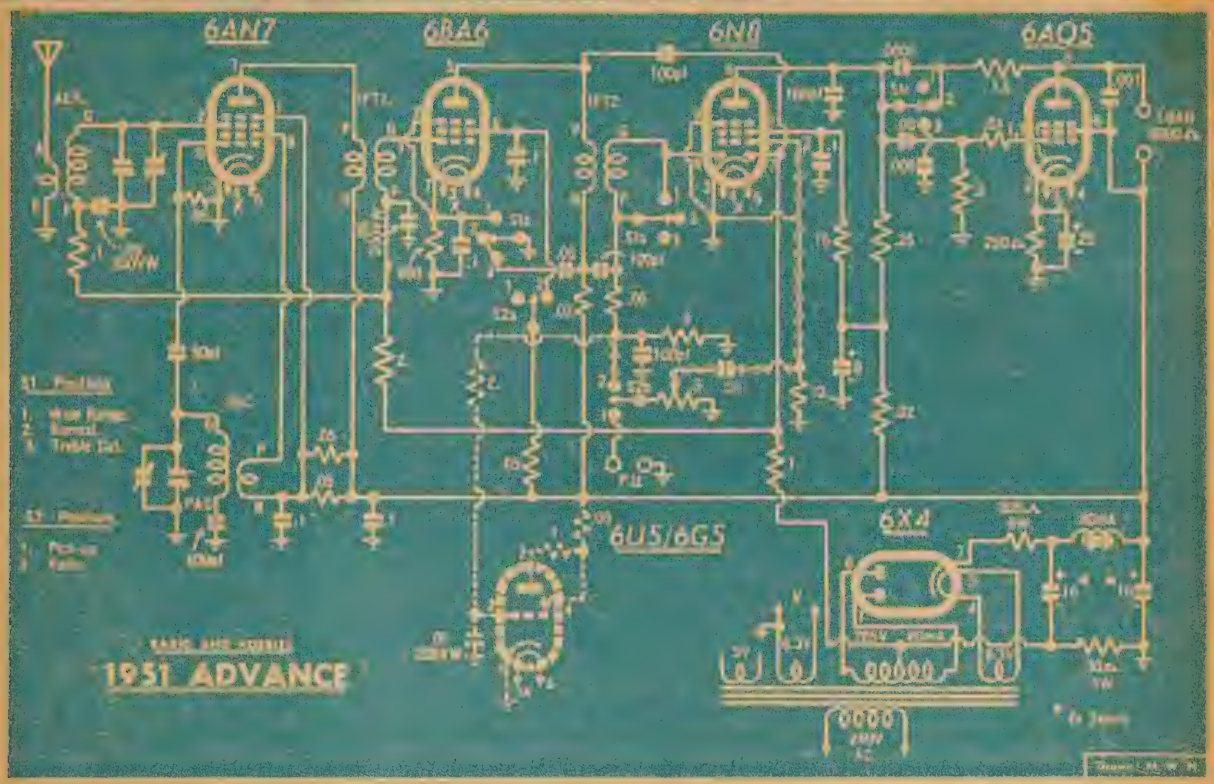
Older type sets also work on a figure of 250 volts but the power supplies have higher values in the earlier stages, due to the need to energise the speaker field.

TYPICAL VALUES

Common practice in these sets was to use a 385-volt power transformer which would deliver roughly the same DC output to the first filter condenser. Then followed the field coil as a filter choke and this would have anything from 100 to 120 volts developed across it, making the total HT of say, 265 volts.

With anything from 12 to 16 volts required for bias for the output

CIRCUIT DIAGRAM OF THE 1951 ADVANCE



This circuit is typical of many receivers in use today. Refer to the various parts of it as you read the text and, if possible, make similar measurements on your own receiver. Some voltages are higher in old sets but the main ones will be very similar.

valve, the actual plate voltage would be between 250 and 270 volts.

A popular arrangement for mantel sets is to use a transformer delivering 225 volts and, due to the somewhat lighter load, this will deliver a slightly higher DC voltage to the first filter condenser. By the time the filter choke has taken its share the final HT will still be around the 220 volt mark. Bias will still have to be subtracted so that the actual plate voltage of the output stage might well be only 210 volts. Nevertheless the valve will still be capable of adequate performance, even though the maximum output will be less than that with with higher voltages.

BIAS VARIATION

Bias on the output valve is another factor which is subject to variation and, although a general idea can be obtained from valve data books, it is not unusual to find higher values than those specified. This is particularly so in the case of mantel receivers and battery sets, where it is desired to keep the current drain to a minimum.

The audio amplifier is normally a resistance-coupled stage and the measurement of plate and screen voltages in these circumstances is rather difficult with a normal multimeter due to the additional current drain through high values of resistance. (See Radio and Hobbies, March, 1952). Nevertheless, for ordinary routine servicing, sufficient indication can be obtained with a direct reading providing it is realised that it is only an indication and not an actual measurement upon which calculations are to be based.

Coming to the earlier stages of the receiver we find that the total HT voltage is usually applied to the plates of the RF stage (if any), the converter, and the IF valve.

Screen voltages are generally around the 90 to 100 volt mark when the valve is operating with minimum bias but will often rise considerably when the current drain is reduced due to increased bias via the AVC system. In fact, the action of the AVC can effect so many characteristics in this part of the set that it always advisable to make measurements with the aerial removed or the set tuned off a station, otherwise you may start searching for a fault which does not exist.

Most oscillator plates also operate at about 100 volts and it is common practice nowadays to use a single dropping resistor to supply this voltage to the screens and the oscillator plate.

Thus a little experience will tell you that most such circuits will indicate something around the 35 volt mark on the plate and that this actually means about 100 volts. There will be some variation from one set to another but it is generally possible to pick out a gross variation which would indicate a faulty component.

Modern battery receivers use valves designed for maximum HT voltages of 90 and in most cases this is used, although personal portables generally work from 67.5.

With the exception of the output valve, zero bias is used while all the screens are designed to work at 90 volts, or what ever is the HT voltage. In older battery sets and vibrator sets 135 volts was a common HT figure, and car radio using vibrator packs and AC type valves are more like an AC set and will have a HT from 180 volts to 250.

The foregoing is a necessarily brief review of general designs, it quite obviously being impossible to treat every small variation from one design to another, but it should serve to establish some kind of a standard by which the beginner can begin to make some progress.

But it really only answers the first half of the question, "What voltages can be expected in a typical set?" and we have yet to deal with the second part, "By how much can these vary without effecting the performance of the set?"

NORMAL TOLERANCES

In the first place we find that set manufacturers do not expect individual sets, made to the same design and to all intents and purposes identical, to be closer to nominal specified values than plus or minus 10 pc. Thus a set designed for a nominal HT voltage of 250 may read anything from 225 volts to 275 volts.

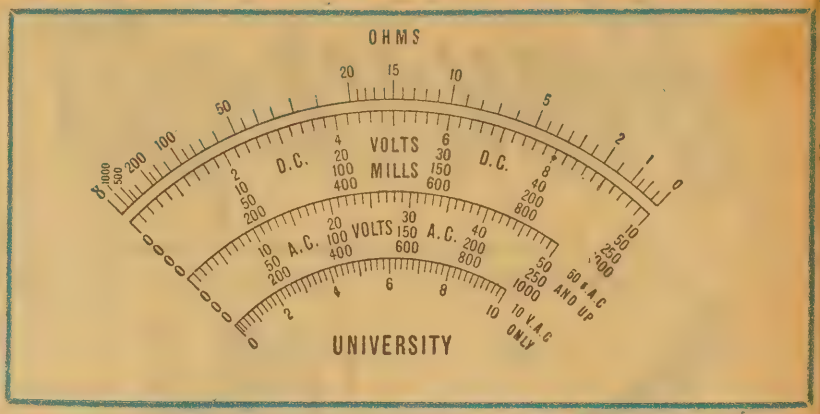
This, then, is the standard for sets which are nominally identical, but to this variation we must add those due to differences of design from one maker to another. The total result is that a set might operate on anything from 200 to 300 volts of HT and still be quite normal.

On the other hand a HT voltage as low as 200 or as high as 300 could also be a symptom of a fault, but the important point is that it is only a symptom. It is not the fault for which you are searching, and it will not, in itself, stop the set from functioning. The inference, therefore, is that the set has failed, not because the HT voltage has dropped to 200, but because of some other, more definite, fault which produces a lowered HT voltage as a by-product.

In such cases one should make a mental note that the voltage is on the low side and, while remembering that is could simply be the design of the set, proceed to check for those faults which could cause such a reduction.

For example, it could be that a screen by-pass condenser in one of the earlier stages had shorted, thus rendering the set inoperative by removing the screen voltage and, at the same time, reducing the HT voltage by placing an additional current drain on the power supply.

A TYPICAL MULTIMETER SCALE



This scale is similar to the one on your multimeter. Note that the AC voltages should be read on two ranges, the lower one for low values and the middle one for the remainder. The next one is for both voltage and current and the resistance range is right at the top.

RESISTANCE CHECK

There are many such examples but it might be easier if we were to take a typical circuit and go over it as we would if there were a fault in it.

We have selected the "1951 Advance," mainly because it is of fairly modern design, is reasonably typical and provides an opportunity to talk about both self and back-bias.

It is also interesting in that we have no records of the actual voltages present in the original chassis, and this has long since been stripped down in the interests of progress. The values we will quote, therefore, are simply estimates based on the information available in the circuit, so that we are in much the same position as a serviceman presented with a receiver of unknown characteristics.

The first check on any faulty set should really be a visual one, first with the power off and then with it on. With the power off you should check for such things as obvious loose connections, overheated components, or any form of mechanical damage. This need not take more than a minute or two and will often result in spotting the trouble right away.

When the power is switched on watch for such things as overheating resistors, distress in the rectifier (blue flashes fireworks etc.), or a red-hot screen in the output valve. The latter almost invariably means an open circuited speaker transformer.

SAFETY PRECAUTIONS

In the event of any of these symptoms showing, the ohm-meter should be brought into service to check the suspected part of the circuit and the fault will normally show up as a gross error in resistance, usually a short or open circuit.

However, with no such obvious faults, the next step is to check the HT voltage. In our Advance circuit this should be very close to 250 volts with about 290 at the rectifier cathode and about 40 across the 300 ohm resistor and filter choke combined.

If the HT voltage was very low, say 30 or 40 volts, or non-existent it could be due to a short or partial short somewhere in the HT system (most likely the second filter condenser), a faulty rectifier or a combination of both, the second having been caused by the first.

If a short is suspected the set should be switched off (most important) and the resistance between the HT line and chassis measured. In this circuit it would appear that there is no path between these two points when the valves are cold except the leakage of the electrolytic condensers.

In some circuits there is a bleed circuit provided and the resistance would be between 15,000 and 50,000 ohms. A reading of only three or four thousand ohms would indicate trouble.

If no short is apparent the trouble is most likely in the rectifier, but the AC voltage applied to the rectifier plates should first be checked before concentrating on the valve. The voltage from the two halves of the power transformer should be essentially equal.

If there is no fault in the power supply and the HT voltage is more or less normal, the next port of call is the output valve. There is a very good reason for checking in this order.

HIGH POWER

The power supply and the output valve handle considerable power, relative to the rest of the set, and a fault in these sections is much more likely to damage an expensive component if allowed to remain more than a few minutes. Thus it is desirable to clear these of suspicion early in the piece, after which the set can be left running for other tests without serious risk.

A voltage check of the power valve (6AQ5) should show a screen voltage equal to the HT voltage, a plate voltage some five or ten volts lower (due to the DC resistance of the speaker transformer), and a bias somewhere around the figure set by the valve manufacturers for that particular plate and screen voltage. It should not be appreciably less than this but there are many cases where it may be higher.

In the circuit we are considering, the self-bias resistor of 250 ohms, in conjunction with operating conditions which follow published figures very closely, should result in a bias of 12.5 volts, which is also the published figure.

The voltage across the bias resistor particularly when self bias is used, is a very valuable measurement, since it is really a measure of the plate current. You can measure the plate current directly, of course, but the voltage reading is easier and for this reason is often the first indication of something wrong. The following are some examples:

VALUABLE READING

An output valve which has passed its prime and is drawing only a small fraction of its rated current will produce a bias voltage much lower than normal while at the same time the HT voltage will rise due to the reduced load.

On the other hand a leaky electrolytic across the bias resistor will also result in a low bias, but now the plate current will be increased and the HT voltage probably low. (Now you can appreciate that the value of the HT voltage can be very significant—when viewed in the light of other symtoms.)

Another effect is that of a leaky coupling condenser. Because one side is connected to the plate of the preceding valve it must have a very low leakage if the positive voltage at this

Estimated Voltages for "1951 Advance"

All voltages referred to Chassis:—

	Volts	mA
6X4 Cathode	290	70
HT Line	250	
6AQ5 Plate	240	45
" Screen	250	4.5
" Cathode	12.5	
6N8 Plate	25	.8
" Screen	20	.2
6BA6 Plate	250	6
" Screen	100	2.5
" Cathode	6	
6AN7 Plate	250	3
" Screen	90	3
" Osc. Plate	90	4

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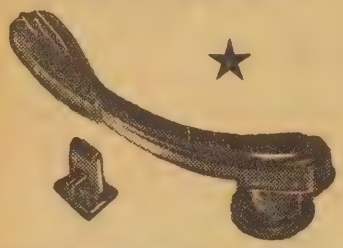

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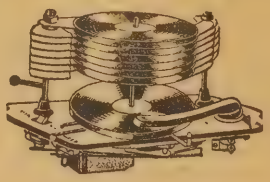

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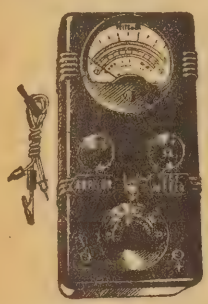

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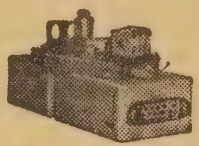

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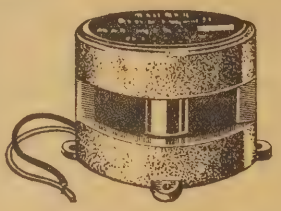

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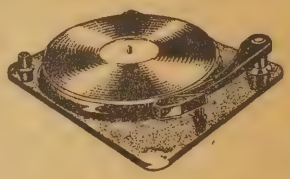

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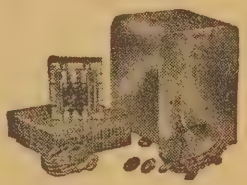

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point is not to be applied to the grid of the power valve. When the condenser becomes leaky and positive voltage is applied, it can either reduce the negative bias, eliminate it altogether, or make the grid positive with respect to cathode according to the extent of the leakage.

In any case the effect will be to increase the plate current, reduce the HT voltage, and increase the voltage generated across the bias resistor. (In this case, this voltage is no longer the true bias.)

POSITIVE BIAS

If these latter symtoms are noted, a voltage reading between the actual grid and cathode will usually confirm the trouble. Normally, there should be a slight negative indication (correct voltage cannot be read due to the high value of grid resistance) but with a leaky condenser there may be none or a slightly positive one. In this case removing the coupling condenser will usually restore the operating voltages to normal.

If the output stage is back biased similar effect will be noted across the back bias resistor but they will not be so pronounced due to the additional currents for the front end of the set tending to swamp those of the output stage.

While probing around this part of the set you will find that is it quite easy to get some idea of whether the the output stage is functioning in the dynamic sense, i.e, whether it will actually pass signals. This is done simply by noting whether a prod touched to the grid of the valve gives any indication in the speaker, a stage which is functioning normally giving a distant click when the connection is made.

If the output stage appears correct we proceed to the audio stage (6N8) and it is here that we run into problems of accurate voltage measurement due to the high resistance in the plate and screen circuit. Probable readings would be around 28 volts for the screen and 25 volts for the plate. These readings do not tell the true story of the voltages applied, but they do indicate that voltage is present and that this section of the set should at least work.

Current reading of the plate and screen can also be useful if it is suspected that the valve is not operating correctly. In resistance coupled stages these are never very high (nothing like the values quoted for the same valve when transformer coupled) and from 0.5 to 0.8 for the plate and from 0.1 to 0.2 for the screen would be typical values.

While making these measurements, you can also check that signals from the plate of the 6N8 will reach the speaker, once again by observing whether the placing of the prod on the plate connection will produce a click in the speaker, and it should be of the same order as that from the grid of the 6AQ5.

The bias for this valve is not easy to measure with a standard meter, being self-generated by means of the 10 meg. resistor in the grid circuit. However, providing the resistor is intact and the valve drawing normal plate and screen current, there is not much to worry about in this regard, and a more important job is to check the grid of this valve for sensitivity.

With older types of valves it was customary to place the finger on th grid cap, when a normal set woul make rude noises in the speake With modern single-ended valve the grid is not so readily availabl for finger-prodding.

This should produce much loude clicks when touched to this point tha any of the previous ones, due to th higher gain; while, if you care to hol the other end of the lead (but d make sure it is really touching th grid pin and nothing else), the sam loud and distorted hum, or blur will be heard from the speaker.

It should be possible to trace th rest of the audio circuit through th volume control and to the IF trans former secondary by means of thi blurp injection technique and, if a is well this far, we will have to chec further toward the front for th fault.

VARIABLE SELECTIVITY

This part of the "Advance" receive involves the somewhat complicate circuitry of the variable selectivity system, whereby one tuned stage i replaced by resistance coupling; but in testing such a set, it would b wiser to ignore this and set the controls for normal operation. In thes circumstances the set will behave exactly the same as any typical five valve set.

The plate voltage of the 6BA6 wil be the same as the HT voltage, there being very little resistance in the IF transformer windings, and the drop is negligible. These windings sometimes go open circuit which, of course will show up in the case of the primary winding as an absence of voltage on the plate of the 6BA6. However, there are no measurable

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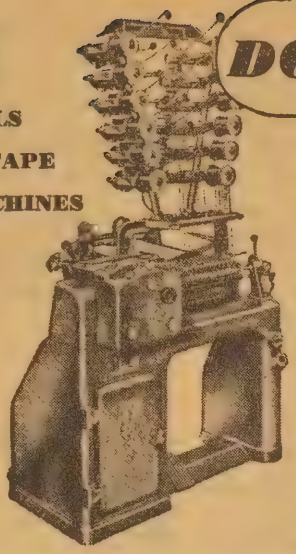

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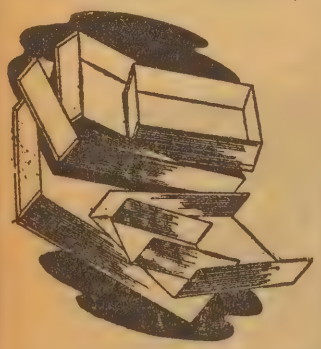

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voltages in the secondary winding, and it will be necessary to test this with the ohmmeter.

While measuring the 6BA6 plate voltage it should be possible to produce some clicks in the speaker if the set is functioning from this point on, but it is not possible to inject hum into the circuit because the IF transformers will not work at audio frequencies.

SCREEN VOLTAGES

The screen of the 6BA6 is designed to operate at 100 volts, and it is most likely that this voltage will be aimed at in the original design, since it is one of the major factors governing the performance of the valve.

Thus, regardless of the intended HT voltage, most designers work on the basis of maintaining the screen voltage at that recommended by the valve manufacturers. This can often be a clue as to whether a low HT voltage is intentional or not, a screen voltage much below the recommended figure indicating that it is not, while a normal figure would indicate that the reduced HT had been allowed for.

The screen current in such stages will be much higher than that in resistance-coupled stages, around the four or five mA. mark, with the result that much lower values of resistance are required to reduce the voltage, and the loading effect of the meter is almost negligible. They may usually be read directly without any reservations.

Bias for this stage comes from two sources, the 600 ohm self-bias resistor and the 30 ohm back bias resistor in the power supply. The latter is connected from the power transformer centre tap to chassis and the AVC line is connected to the junction. About two volts will be developed across this resistor, and a little Ohm's law calculation is often a help in cases like this.

The bias generated by the self-bias resistor is dependent on the current flow through the valve, and this, in turn, depends on the bias applied from other sources, notably the AVC system. It is for this reason that the set should be tuned off a station when measurements are being made. Under these conditions the voltage across the 600 ohm resistor should be in the order of four to six volts.

CONVERTER

If all voltages appear correct for this stage and there are indications of life from both the plate and grid circuits the next step is to check the converter stage, the 6AN7. The plate voltage will once again be equal to the HT supply, while a common dropping resistor is used for the screen and oscillator plate supply. The latter will probably be about 90 volts and, as in the case of the 6BA6, there are no problems created by the drain of the meter in circuits of this kind.

A possible fault in this part of a circuit is the failure of the oscillator section and the symptoms can be rather puzzling for the beginner. The set will sound "alive" and when connected to an aerial will receive static and electrical noise or even an occasional Morse signal, but not a sign of the local stations.

What happens is that the failure of the local oscillator prevents the incoming signal from being changed to the intermediate frequency, with the result that the set is really tuned to this frequency all the time and

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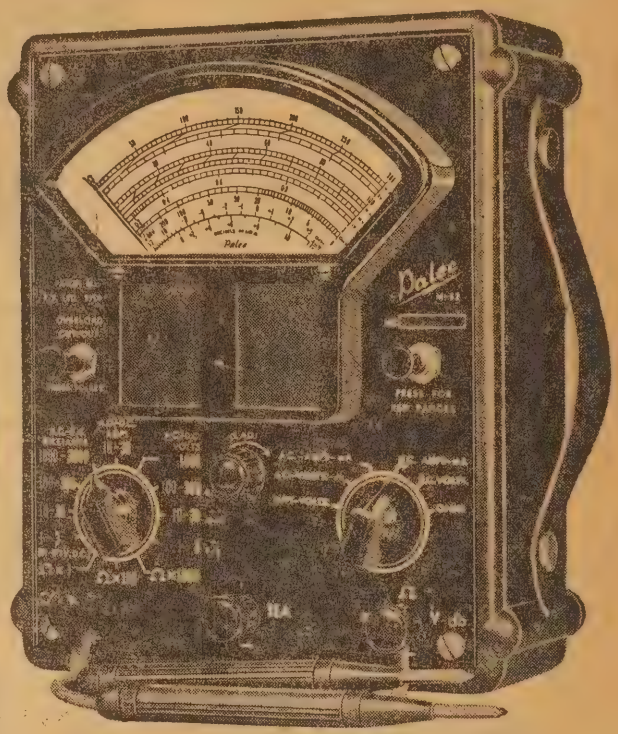

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Ranges

Volts D.C. 0/0.1-3-10-30-100-300-1000	7
Volts A.C. 0/3-10-30-100-300-1000	6
Current D.C. 0/1-3-10-30-100-300-1000 mA.	7
Current A.C. 0/1 mA. (for use with ext. current transformers)	1
Ohms 0/1000: 0/10000: 0/1 megohms	3
Decibels Ref. level 1 mW. in 600 ohms	3
„ Ref. level 6 mW. in 600 ohms	3
Total	30

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from which it receives static and noise but no signals.

If all the voltages appear normal it is a good idea to check for oscillator grid current, an absence of which will indicate that the valve is not oscillating. This can be done by disconnecting the cathode end of the grid resistor and inserting the milliammeter in series. The current will be in the order of 200 to 300 microamps (.2 to .3 mA) and the 0-1 mA range should be used.

6AN7 BIAS

The bias for the 6AN7 is derived solely from the back bias network and, beyond checking that the grid return circuit is continuous, there is no need to check further. From the plate and signal grid (pin 2) of this valve some really healthy clicks should be audible in the speaker if all is well, except that, as already explained, signals will pass through the set even though the local oscillator is not working.

Which just about completes the voltage check and it is most likely that a faulty set will have revealed some defect before this unless it is one which does not affect the voltages in any way. Some idea of the section of the set which is at fault can be gained from its response to the click technique and once this has been done the location of the faulty component is relatively simple.

Some of the faults which do not show up as a voltage variation can be detected with the ohmmeter. An example of this is a short circuit across any of the coils and which could be due to the failure of the condenser which is used to tune it. This applies to the IF transformers as well as the aerial and oscillator coils, the small fixed condensers being the offenders in the former and the trimmers in the latter. It doesn't often happen, but it's not unknown.

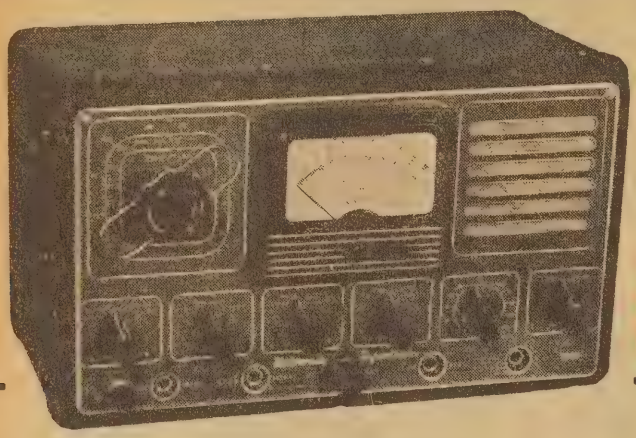
The low ohms range is very valuable here, making it possible to distinguish between the relatively low resistance of the winding (about 10 ohms) and a short circuit.

And that should give you a fair idea of how to use your meter to check a faulty set. Of necessity, only the main points have been covered, it being clearly impossible to describe the symptoms of every type of fault to which sets are prone. Nevertheless, it should give you a solid basis on which to work, enabling you to tackle jobs which will yield valuable experience and increase your confidence.

WE HAVE NOTICED!

- That a-c meter scales are frequently read incorrectly. Some a-c scales are shorter overall than the d-c scales, so that a mistake gives a large reading error. Even with scales the same length don't forget that the low voltage ranges have separate graduations.
- That multimeters are often left on the "ohms" range. The batteries will discharge if the tips hang together and it is easy also to apply voltage between the tips before the range is selected. Cultivate the habit of removing the test prod altogether after each measurement or running the switch back to a high voltage range. Better this than a damaged meter!

Modern Methods with a Modern Instrument . . .



The UNIVERSITY Model AST SUPERTRACER

To be really up-to-date, to be able to do service work speedily and accurately, you must have the right testing equipment, and the test unit which has all the requirements is the University AST Supertracer.

This is the most modern, up-to-date, and efficient service instrument that anyone could desire. It is easy to use and gives rapid and accurate location of faults in radio receivers and similar equipment. It speeds up testing, servicing, and production, and will rapidly detect faults which render a receiver inoperative, or which make it intermittent or lacking in sensitivity, or which cause oscillation, distortion or hum.

The instrument comprises a two-stage tuned R.F. amplifier, diode detector, and two-stage A.F Amplifier and, of course, a loudspeaker and power supply. In addition, a vacuum tube voltmeter measuring up to 500 volts A.C. or D.C. at a resistance of 11 megohms on D.C. and 10 megohms on A.C is provided. The tuning range of the R.F. circuits is 175 to 490 K.C., 550 to 1550 K.C., 1.5 to 4 megacycles, and 6.3 to 18 megacycles R.F. sensitivity is such that input voltage of the order of a few millivolts may be detected on all ranges so that the instrument is suitable for use in any district where alternating power mains are available. A capacity type R.F. multiplier in the input circuits in conjunction with the V.T.V.M enables stage gain measurements to be made.

TEST PROBES: The R.F. test probe is fitted internally with a very small series capacity of a few micro-microfarads, so that it does not produce an appreciate detuning effect when applied to the grid or plate of R.F. or I.F. stages in a receiver. The A.F. test probe is a conventional shielded lead for feeding A.F. into the tracer or A.F. out from the tracer for testing A.F. amplifiers or speakers. The D.C. probe contains a series 1 meg isolating resistor, so that the V.T.V.M. may be used to measure plate bias or A.V.C. voltage under actual operating conditions without disturbing the action of a receiver.

VACUUM TUBE VOLTMETER: The V.T.V.M features a centre zero scale for direct voltage measurement, so that voltages which are either positive, or negative with respect to a receiver's chassis are instantly indicated without the necessity of reversing test leads or operating a reversing switch. Zero is at the left for alternating voltage ranges, and operation covers the audio frequency range. Voltage ranges are 0/5, 0/25, 0/100, and 0/500 volts at an input resistance of 11 megohms on D.C and 10 megohms on A.C. ranges. In conjunction with the amplifying stages of the tracer, the meter will indicate R.F. or A.F. voltages down to a value less than 1 millivolt. Indications are provided by a large, clearly marked rectangular meter with illuminated scale fitted in an attractive modern plastic case measuring 4¾" x 4". The V.T.V.M. and tracer may be used simultaneously for observing signals at two distinct points in a receiver. This feature greatly facilitates location of intermittent faults. Operates from A.C. 220 to 260 Volts.

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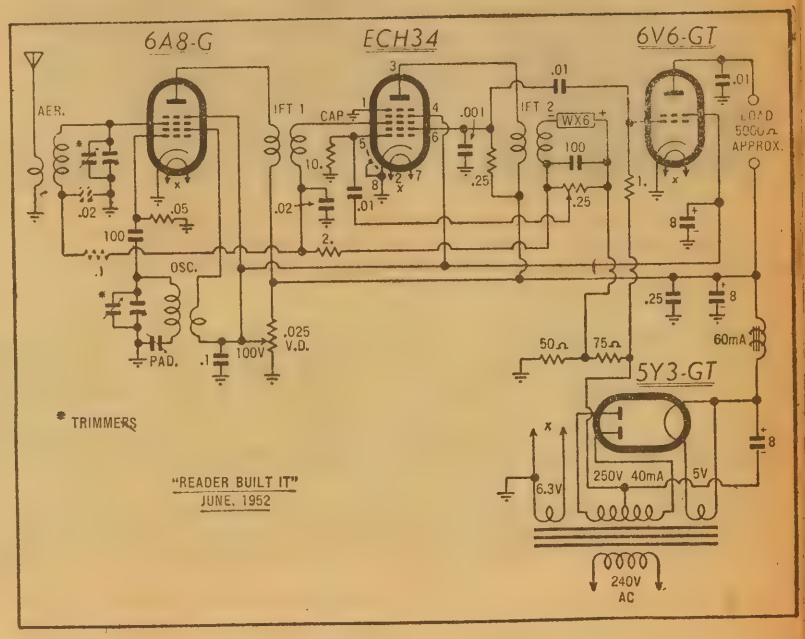
A READER BUILT IT!

Gadgets and circuits which we have not actually tried out, but published for the general interest of beginners and experimenters.

5-VALVE PERFORMANCE WITH ONLY FOUR VALVES

There is always some design which is just sufficiently different as to be of interest. Here are the details of a set submitted by a reader from Western Australia which could well be what some constructors are seeking in order to use certain components on hand.



OUR contributor, Mr. A. J. Gardner, of 22 Queens Crescent, Mt. Lowley, Western Australia, says that with the triode-hexode in the second stage and a miniature dry rectifier for detection and AVC, this set will have much the same performance as a standard five-valve set. It would make up into a handy mantel set and, with a little thought to component layout, the Little General chassis, prior to the 1951 version, could be used without having to cut any new holes.

Dealing with the circuit design, a 6A8G was used in the converter stage in conjunction with a dual-wave coil unit. Naturally, the more modern types, such as the 6J8GA, ECH35, X61M, 6AN7, would be a possible choice, but, for straight broadcast use, almost any converter valve will do.

Of the older types, such as the 6A8G, 6J8G, 6K8G, the 6A8G would be the pick for straight broadcast use and the 6J8G for dual-wave use with a 16 to 50 metre coil unit. For a 13 to 42 metre coil unit the 6K8G may do better at the extreme high frequency end of the tuning range.

AVC LINE BIAS

The valve is biased through the AVC line, and the oscillator anode and pentode screen is fed from a 100-volt tapping on a voltage divider across the HT supply. Developed AVC voltage from external noise or signal will ensure that the 6A8G has a minimum of three volts of bias.

The ECH34 performs a dual function of IF amplification and audio preamplification. Possibly, certain other triode-hexode and triode-pentode valves could be used here, but a point to bear in mind is that RF on the elements handling the demodulated audio signal may be fed back to the hexode portion through internal capacitance and cause IF instability. Apparently, our correspondent had no trouble in this respect.

If encountered, however, a possible cure may be to install an RF filter between the F terminal of the IF No. 2 and all that connects thereto. Such a filter would consist of a .1 megohm resistor with 100 pf capacitors from each end to chassis. The existing 100 pf from the F terminal to the back-bias tapping can act as one of them.

At this stage two points arise and in connection with which we took the liberty of modifying the circuit.

The original position of the volume control and inadequate provision of bias for the triode audio stage could lead to possible overload and distortion on very strong local stations. Probably our contributor's location is such that these points have not been rendered apparent.

We transferred the volume control from the grid circuit of the 6V6GT to the position of diode load and increased the value of the triode audio stage grid resistor to 10 megohms to provide grid-leak biasing.

Another method would be to leave the triode grid resistor at 1 megohm and return it to the tapping in the back-bias through a decoupling network of a .5 meg. resistor and a . mfd capacitor at the junction of the 1 meg. and the .5 meg.

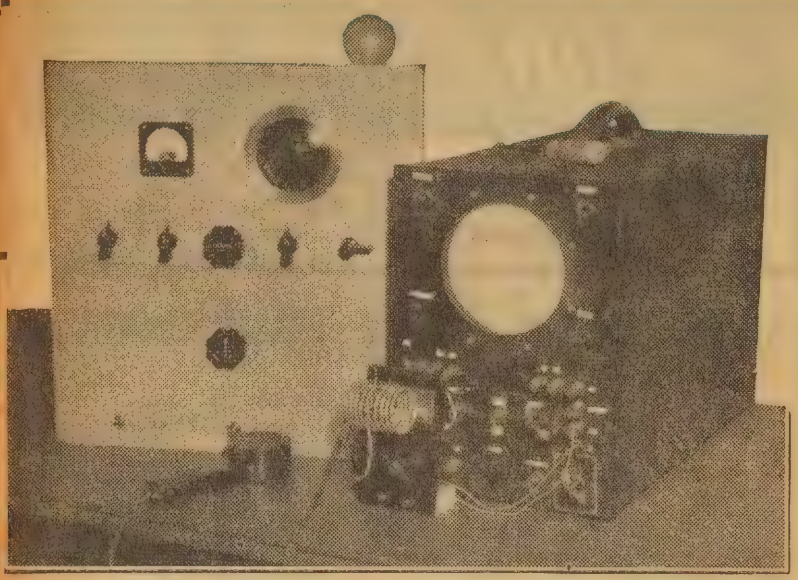
Alternatively, the "bottom" end of the volume control could be removed from the back-bias tapping and earthed and the first two stages cathode-biased with 300 ohms for the 6A8G and 200 ohms for the ECH34 each resistor being bypassed with a .1 mfd capacitor.

The 6V6GT is operated with 100 volts on the screen, 250 volts to the plate and a bias of minus 5 volts. Data sheets suggest an output of 11 watts under these conditions for five volts of grid drive. The optimum load impedance is 14,000 ohms, but anything from 5000 ohms upwards will work satisfactorily.

In the power supply the 250 volts-a-side 40 mA transformer is not necessarily a standard size. A 225 volts-a-side 50 mA could be used without change to circuitry. For transformers much over 250 volts a side it will be necessary to connect a wirewound dropping resistor of appropriate value between the rectifier filament and the junction of the choke and the first filter capacitor.

PERHAPS YOU...

have built some particular set or other piece of equipment which you have found to give good results. If you think that it would be of interest to other experimenters, send along as much information about it as you can. If it is considered suitable and is subsequently published on this page we will pay an appropriate publication fee.



This picture shows the arrangement of the transmitter, modulator and cathode ray oscilloscope which was used while making the tests described in the article. The coil in the foreground is connected with the vertical plates of the CRO and link coupled to the transmitter. The 15 watt load lamp can be seen over the transmitter panel.

ADJUSTING YOUR NEW XMITTER

Before you connect your transmitter to an aerial and send out the first CQ you should make sure that it is adjusted for best efficiency and so that it will occupy a minimum of space on the band. This sometimes neglected phase of amateur radio is extremely important and gives an opportunity for some real experimental work, and an appreciation of the value of test equipment.

by Maurice Findlay

THE correct operation of a transmitter on CW introduces special problems, as does also the correct operation of a phone transmitter. Both sets of problems must be solved separately and their solution amalgamated in the final design. Here, we discuss the problems in relation to our new transmitter.

A CW transmitter is required to send out a series of short bursts of radio frequency energy on one particular frequency. By varying the length of the pulses, dots and dashes can be formed, and these dots and dashes can, in turn, be combined in various ways to form a code. All amateurs will be familiar with the international morse code, because they have to pass an examination in both sending and receiving before they are issued with their operator's certificate of proficiency.

KEYING PROBLEMS

In practice there are quite a number of difficulties in keeping a transmitter, so that its output is maintained on exactly the same frequency when it is required to follow keying.

Radiation on other than the required frequency may be due to one or both of two principal causes. The first was mentioned in the article describing the four-band transmitter in the April issue.

Briefly, if the frequency-controlling device of the transmitter is sensitive to changes in supply voltage, it is necessary to maintain the supply voltage at a constant figure during keying. If not, there will be a slight change in frequency, heard as a "chirp" on the air. The characteristics of the "chirp" are affected by the exact regulation and time constant characteristics of the power supply.

In the case of the four-band transmitter we used a power supply which is inherently well regulated, and the oscillator, being crystal-controlled, is likewise insensitive to changes in supply voltage.

In the second instance, spurious radiation can be caused by switching the transmitter on and off too quickly. The effect is much the same as the familiar "click" when an electric light is switched on. You may have observed that it often causes interference over all the normal broadcast and shortwave bands.

The click caused by keying an amateur transmitter is usually confined to within a few hundred Kc of the operating frequency, due to the selectivity of the aerial-tuned circuits. The people you are most likely to annoy with a badly-adjusted transmitter are your fellow-amateurs.

Of course, the official PMG monitoring stations are also on the lookout for such signals, because they may annoy regular shortwave listeners.

INTERFERENCE

A badly-designed transmitter may further be subject to parasitic oscillations which cause interference on adjacent frequencies, but this is another problem.

Testing for clicks is largely a matter of listening to the signal as it is transmitted on the air. The station receiver is generally suitable for the purpose, although it is sometimes difficult to reduce the level sufficiently to avoid overload when testing in the vicinity of the transmitter.

If you can obtain the co-operation of an amateur living within a mile or so of your station, you will be able to get an excellent check. Possibly he will be interested in the same problem, and willing to swap stations with you for an hour or so for your mutual benefit.

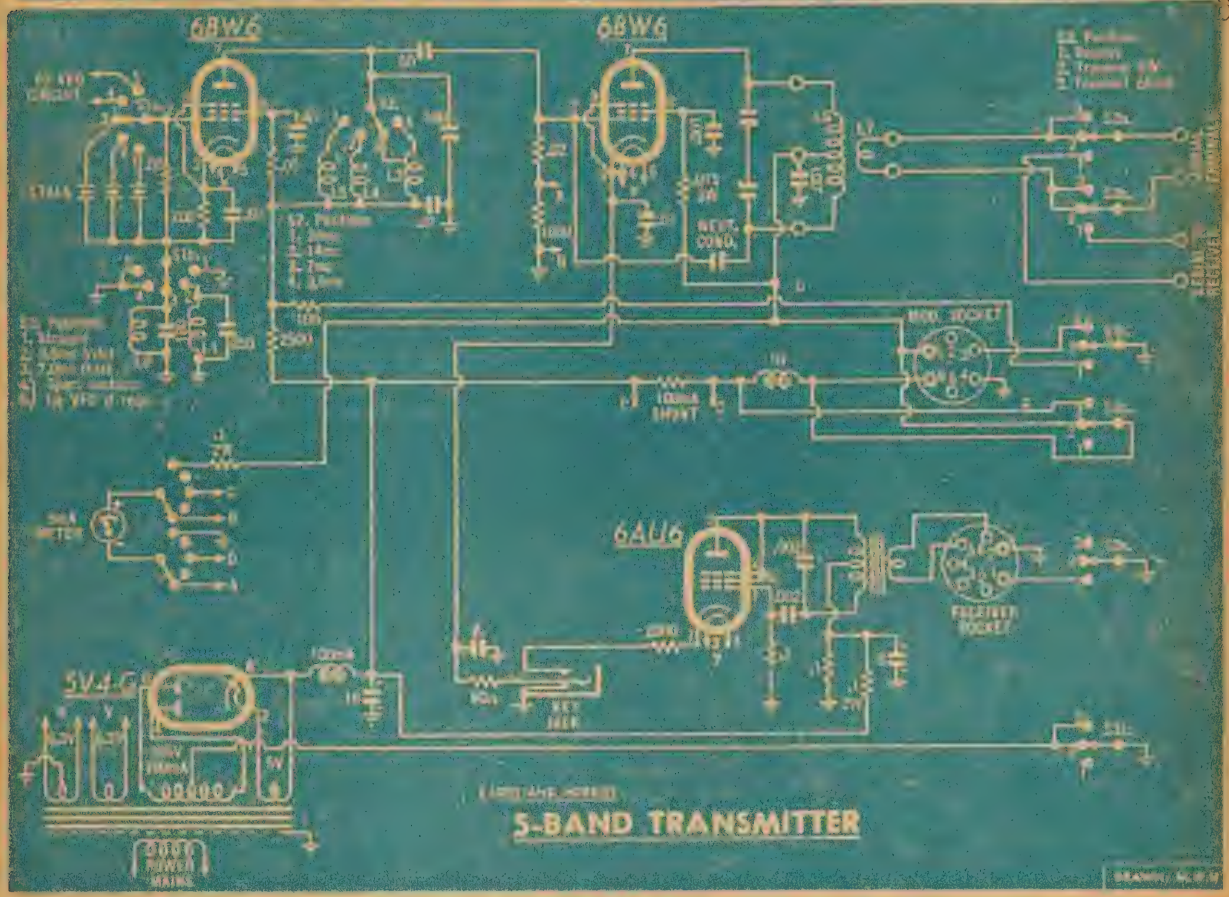
If not, the best you can do is to try and reduce the level of the signal fed into the receiver to the point where it does not overload. This is most important, because an overloaded receiver can give the effect of clicks, even from a well-adjusted transmitter.

In practically every case it will be necessary to disconnect the aerial and short out the aerial terminals. If the receiver has a sensitivity control, this should be turned to minimum. The idea is to reduce the gain of the receiver to a point where it is possible to tune in the signal, with the AVC switched off and the BFO on, without any sign of overload.

When you can do this, switch the BFO off and try listening for clicks around the particular band while keying the transmitter. If you have not made any special provision to prevent it, the chances are that there will be a noticeable click both as the key is opened and as the key is closed.

It is just possible that the click would be caused partly by RF get-

CIRCUIT FEATURES MONITOR, KEY-CLICK FILTER



The circuit is the same as that published previously except that it includes a key click filter and an audio oscillator for monitoring. Note also that we have arranged the switching so that the high tension supply for the oscillator is shorted in the receive position. A current limiting resistor is included.

ting directly into the audio system on the receiver. To check that this is not the case, try removing the detector valve, in which case there should be no response from the receiver as the key is opened and closed. A transmitter under 20 watts should not make it necessary to take any special precautions in this regard but, where similar checks are to be made on high-powered transmitters, it may be necessary to shield the receiver completely.

KEYING CHARACTERISTIC

The next job is to adjust the keying for the most desirable characteristics. Checks among experienced operators have shown that the signal which is easiest to copy has a sharp "make" characteristic and a soft "break." Signals which have a soft make and a sharp break tend to be confusing. Our aim, therefore, is to adjust the transmitter so that the click is barely audible as the key is closed, and no click at all as the key is opened. With the transmitter correctly adjusted, nearby amateurs should be able to receive within a few kc of your transmitting frequency without experiencing interference, provided their receivers are up to standard.

The most suitable method of delaying the rise in carrier strength to its full value is to wire a small choke in series with the cathode lead.

The "break" characteristic can be made softer by wiring a condenser across the key terminals. When the key is closed the condenser is discharged but, when it is opened, the condenser becomes charged to the voltage required to cut off the plate current of the valve. The condenser takes a definite amount of time to charge, during which time the output valve is still drawing current. In other words, the signal emitted decreases in strength gradually instead of being cut off suddenly.

The effects of the choke and condenser are somewhat interdependant and, in practice, it is usually easiest to find the values experimentally. They depend on the voltage and current of the stage being keyed and may vary between .5 and 30 henries in the case of the choke and .1 and 2 mfd in the case of the condenser.

The aim is to adjust for a slight click as the key is pressed and no click as the key is lifted. This is with the receiver tuned to the operating frequency.

With the receiver tuned a few kc away from the transmitter's frequency, no click should be audible on the make.

If an excessively large value of capacitor is used, the transmitted characters will have long "tails," causing successive dots and dashes to run into one another during high-speed sending.

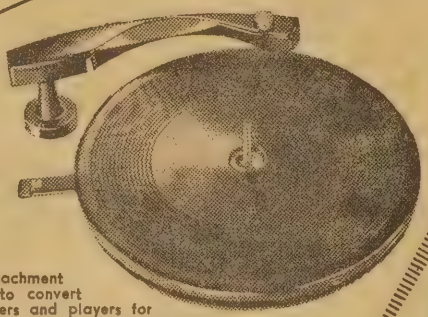
With the above requirements in mind, we carried out some experiments with a 4-band transmitter in order to determine suitable constants for the click filter. It was found that a choke with about 1 henry inductance used in conjunction with a 2 mfd condenser gave about the optimum characteristic.

CHOKE DETAILS

The choke was made by winding 1000 turns of 35 gauge B and S enam. wire on the core of a small speaker transformer. In our particular case the assembled laminations were 1½in x 1¾in x ½in thick. A cardboard bobbin (½in x ½in core) was made to fit the laminations and the wire wound on with the aid of a hand-drill. A layer of brown paper was placed between every few layers of wire to minimise the possibility of shorts between turns.

The inductance value is not particularly critical, so you can go ahead and wind up the choke without worrying about checking its inductance. Also, any paper condenser between about 1 and 2 mfd and rated at 200 volts or higher will be suitable.

U.R.D. FOR MICROGROOVE



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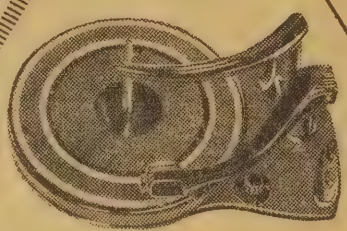

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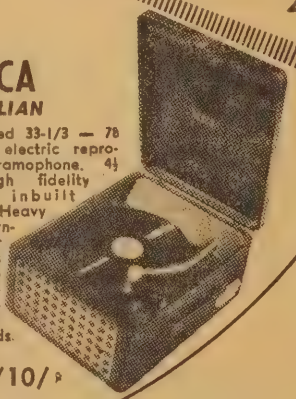

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Conventionally, the click filter choke is placed in the cathode circuit but, in our case, it would have been necessary to provide an extra bank on the switch to short it out when it is required to operate the transmitter on phone. As it is, we have wired the choke in the plate circuit, where it is equally effective.

The switching is so arranged that the modulation transformer secondary is shorted when the transmitter is required to be keyed and the same section of the switch is used to short the click filter choke when the transmitter is modulated. The 2mfd click filter condenser remains in the cathode circuit. Note its position in relation to the 50 ohm bias resistor.

CONTACT SPARKING

The latter, in addition to providing bias, limits the peak discharge current of the condenser and hence prevents excessive sparking at the key contacts.

Ordinarily, the amount of sparking at the key contacts is so low that it will not be troublesome, unless there is a broadcast receiver operated in the very near vicinity of the transmitter. The transient caused by the spark at the key contacts is not radiated by the aerial but only by the leads connecting the key with the transmitter. This radiation can be prevented by installing an RF filter at the key terminals. We have included a suitable circuit should you find this necessary. Once again the constants are not particularly critical.

By the way, if you are checking for clicks with the station's receiver, it is a good idea to include such a filter so that sparking at the key will not be confused with radiated clicks.

To illustrate the effectiveness of the click filter, we set the transmitter up with a cathode ray oscilloscope and an ex-Disposals radar switching motor in place of the key. This allowed the oscilloscope sweep to be synchronised with the keying rate.

The pictures of the oscilloscope screen show the modification of the RF pulse caused by the filter. When the pictures were taken a 1.0 mfd condenser was installed instead on the 2.0 mfd condenser specified by the circuit.

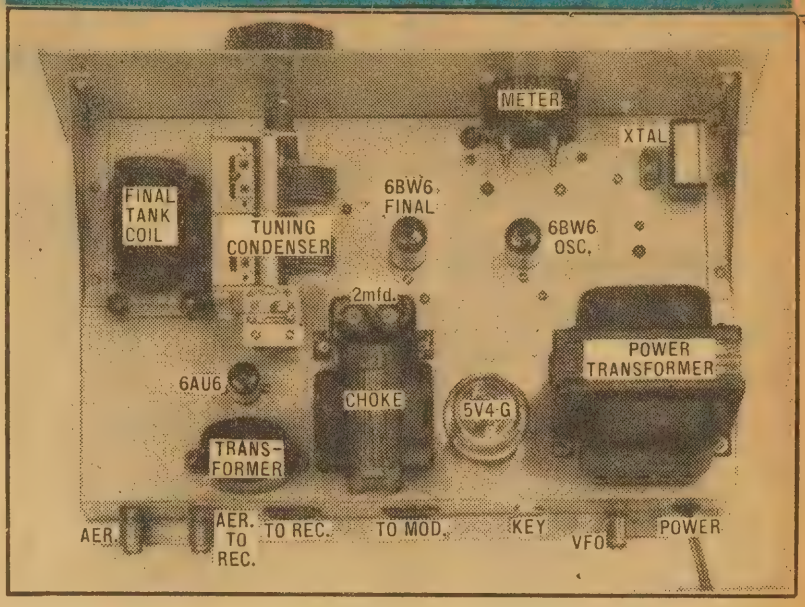
LONGER TAIL

The larger value results in a longer tail on the break side of the pulse but this is quite permissible, since the pulse shown on the screen corresponds to a "dit" sent at a speed of 150 words per minute. It was difficult to use a lower keying speed than this because of the limitations of the cathode ray oscilloscope and photographic problems.

So much for the "click" problem. Now a word about monitoring and such like.

One of the requirements set out in the official handbook for the guidance of the operators of experimental wireless stations is that a satisfactory monitoring system must be maintained and used as a check on all transmissions. The intention of this regulation is that the station be equipped with a device which is capable of simulating the conditions at the receiving end.

A TOP VIEW OF THE CHASSIS



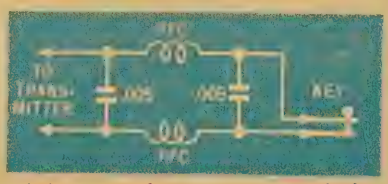
This plan view of the chassis shows the extra parts required for the click filter and keying monitor. The 2.0 mfd paper condenser is mounted in front of the power filter choke and underneath the chassis directly below the condenser is the click filter choke.

For phone signals a tuned circuit with a diode detector and a pair of headphones would be satisfactory. In the case of CW signals it would be necessary to provide an oscillatory circuit capable of generating a signal which can beat with the output of the transmitter to provide an audible beat note. A simple form of regenerative detector feeding into a pair of headphones is the easiest way of meeting the requirement.

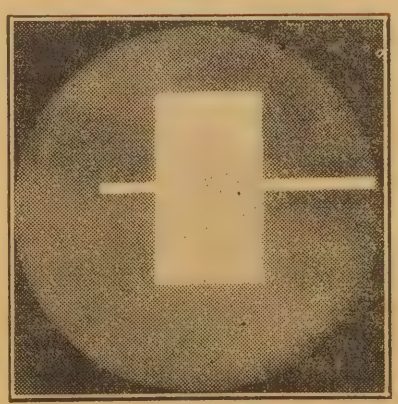
In both cases it is desirable to have a set of changeable coils, either plug-in or switched, and to reset the monitor each time a change in frequency is made. Also, the CW monitor must be switched off while receiving to prevent interference.

With the idea of providing an accessory to the monitor we worked out the circuit of a simple audio oscillator which can be keyed simultaneously with the RF power amplifier and its output fed into the same speaker as the receiver. Thus a direct means of checking your sending is always available if required. The output of the oscillator may be fed into the speaker voice coil in parallel with the output from the receiver.

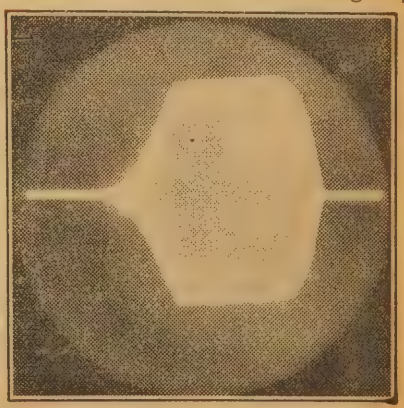
The inductance is an ordinary small push-pull speaker transformer the voice-coil winding of which provides a convenient means of extracting the audio output. The circuit constants shown are satisfactory for the transformer used in the original,



Where interference is created by sparks at the key contacts this circuit should be used. Values are not critical.



The keying waveshape without the click filter is shown in this photograph of the oscilloscope screen. The circuit was closed for about 1/60th of a sec.



With the key click in operation the radio frequency wave takes a definite amount of time to reach its full value. Similarly, the sharp break is eliminated.

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10	30,000 20,000, 14,000, 10,000, 7000, 5000, 2500 PP	2.3	84/11	Universal Test Loud Speaker	OP-53
10	5000, 2500 SE	15, 12.5, 8.4, 6.5, 4, 3, 2.7, 2.3, 2.	88/2		OP-54
10	5000, 2500 SE	15.	85/2		OP-39
10	10,000 PP	15, 8.4, 2.3	79/4	5W Cath Amplifier	OP-85
10	7000 PP	Any ONE of following impedances — 15, 12.5, 8.4, 2.3, 2.	79/4	9W Cath Amplifier	OP-92
15	5000 PP	12.5, 8, 2.3	129/5		OP-2
15	6600 PP	12.5, 8, 2.3	129/5		OP-3
15	10,000 PP	12.5, 8, 2.3	129/5		OP-4
15	10,000, 6600, 5000 PP	12.5, 8, 2.3	129/5		OP-5
15	5000 PP	15, 12.5, 8.4, 6.5, 4, 3, 2.7, 2.3, 2	129/-		OP-55
15	6600 PP	15, 12.5, 8.4, 6.5, 4, 3, 2.7, 2.3, 2	129/-		OP-56
15	10,000 PP	15, 12.5, 8.4, 6.5, 4, 3, 2.7, 2.3, 2	129/-		OP-57
15	10,000, 6600, 5000 PP	15, 12.5, 8.4, 6.5, 4, 3, 2.7, 2.3, 2	130/10		OP-58
25	10,000 6600, 5000 PP	15, 12.5, 8.4, 6.5, 4, 3, 2.7, 2.3, 2	163/9		OP-59
32	10,000 6600, 5000 PP	15, 12.5, 8.4, 6.5, 4, 3, 2.7, 2.3, 2	208/9		OP-60
60	3800 PP	17.6	203/7		OP-36
60	3800 PP	100, 75, 50, 25, 10, 5, 2	238/9		OP-61

P.A. RANGE 50-8000 cps Output to Line

Wts	Primary Impedance	Secondary Impedance	Retail Price	Special Application	Code No.
10	5000, 2500 SE	500	83/9		OP-1A
10	5000, 2500 SE	500, 250, 125	90/8		OP-44
15	5000 PP	500, 250, 125	129/5		OP-6
15	6600 PP	500, 250, 125	129/5		OP-7
15	1000 PP	500, 250, 125	129/5		OP-8
15	10,000 PP	500, 250, 160, 125, 100, 83.5, 71.5, 62.5, 55.5, 50	137/6		OP-8M
15	10,000, 6600, 5000 PP	500, 250, 125	129/5		OP-9
15	5000 PP	600, 300, 200, 150, 130, 100, 75, 50	140/3		OP-34
15	8000 PP	600, 300, 120, 60, 30	245/-		OP-50
25	5000 PP	500, 250, 125	156/3		OP-10
25	6600 PP	500, 250, 125	156/3		OP-11
25	10,000 PP	500, 250, 125	156/3		OP-12

P.A. RANGE Cont.

Wts	Primary Impedance	Secondary Impedance	Retail Price	Special Application	Code No.
25	10,000, 6600, 5000 PP	500, 250, 125	156/3		OP-13
25	10,000, 6600 PP	500, 4000, 8.4, 2.2	200/10	Cutting and Playback Amplifier	OP-35
25	6600 PP	600, 300, 250, 200, 170, 150, 76, 50, 36, 27, 12.5, 7.5, 3.6, 2.7	245/		OP-38
32	5000 PP	500, 250, 125	189/2		OP-14
32	6600 PP	500, 250, 125	189/2		OP-15
32	6600 PP	500, 250, 166, 125, 100, 83.5, 71.5, 62.5, 55.5, 50	192/3		OP-15M
32	10,000 PP	500, 250, 125	189/2		OP-16
32	10,000, 6600, 5000 PP	500, 250, 125	189/2		OP-17
32	6600 PP	140, 70	209/		OP-48
60	3800 PP	500, 250, 125	206/3		OP-18
60	3800 PP	100, 75, 50, 10, 5, 2	238/9		OP-61
80	6400 PP	500, 250, 125	253/2		OP-37
105	8800, 6000 PP	500	382/6		OP-49
150	11,600, 8400 PP	500, 250, 166, 125	481/8		OP-20

HI-FI RANGE 30—15000cps Output to Voice Coil

Wts	Primary Impedance	Secondary Impedance	Retail Price	Special Application	Code No.
5	5000 SE	Any ONE of the following impedances 15, 12.5, 8.4, 6.5, 2.1	88/-	4W Baby Playmaster	OP-24
10	3250 SE	12.5, 8.4, 2.3	132/1	R & H Vox Major	OP-23
10	5000 SE	2	112/6	For Rola 120x Speaker	OP-113
10	5000 PP	2	112/6	For Rola 120x Speaker	OP-117
10	6600 PP	2	112/6	For Rola 120x Speaker	OP-119
10	8000 PP	2	112/6	For Rola 120x Speaker	OP-118
10	10,000 PP	2	112/6	For Rola 120x Speaker	OP-112
15	5000 PP	12.5, 8, 2.3	192/3		OP-19A
15	10,000 PP	15, 3.75	186/11	10W Playmaster	OP-63
15	10,000 PP	12.5, 3.125	186/11		OP64
15	10,000 PP	8.4, 2.1	186/11		OP-65
20	4500 PP	15.5, 12.5, 8.6, 2.7, 2	164/2	15 & 32W Cathamplifiers	OP-51

Output to line

Wts	Primary Impedance	Secondary Impedance	Retail Price	Special Application	Code No.
10	3250 SE	500, 250, 125	132/1		OP-22
15	5000 PP	500, 250, 125	192/3		OP-19B
15	10,000 PP	500, 125	186/11		OP-62

SPECIAL HI-FI RANGE 20-30000 cps

Wts	Primary Impedance	Secondary Impedance	Retail Price	Special Application	Code No.
15	10,000 PP	8.4, 2.1	192/9	For Williamson Amp.	OP25/8.4
15	10,000 PP	10, 2.5	192/9	For Williamson Amp.	OP25/10
15	10,000 PP	12, 3	192/9	For Williamson Amp.	OP25/12
15	10,000 PP	15, 3.75	192/9	For Williamson Amp.	OP25/15
15	10,000 PP	16, 4	192/9	For Williamson Amp.	OP25/16
15	10,000 PP	40, 10	192/9	For Williamson Amp.	OP25/40
15	10,000 PP	250, 62.5	192/9	For Williamson Amp.	OP25/250
15	10,000 PP	500, 125	192/9	For Williamson Amp.	OP25/500
15	5000 PP	8.4, 2.1	235/-		OP-66
15	5000 PP	15. 3.75	235/-		OP-67

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but some modification to the value of the condenser in parallel with the transformer, and also the grid leak, may be necessary with transformers of other types. You will note that the cathode bias resistor is not by-passed, the idea being to obtain a better wave form.

If in practice the output of the oscillator proves to be too great a resistor dividing network in the voice-coil circuit is the best way of reducing it without introducing chirp problems.

Note that this device, which must be considered primarily as an accessory to the transmitter, does not satisfy the PMG requirements with regard to a CW monitor.

The oscillator comes into operation automatically when the change-over is made from send to receive, which is a particularly useful feature, especially where quick exchanges are made between stations.

CHANGEOVER SWITCH

By the way, it is a definite advantage if the "send-receive" switch is of the non-shorting type. A switch of the shorting type allows both the transmitter and the receiver to be in operation simultaneously for a fraction of a second as the change-over is made and may result in feedback.

To assist with this point we have included in the switching circuit provision for shorting the HT supply for the oscillator in the "receive" position. A resistor is included to limit the peak discharge current.

Coming to the matter of voice transmission, if the transmitter and modulator are made according to specifications and the power amplifier correctly neutralised, there is no reason why the quality of the phone should not be good from the first trial. It can be checked by listening in the monitor and you can note the behavior of the meter reading the plate current of the PA. If the modulation is linear it will do no more than flicker slightly during modulation, until 100 pc modulation is exceeded.

However, a more satisfactory check may be made with the aid of a cathode ray oscilloscope. Even if you do not own such an instrument you may be able to borrow one from a fellow amateur. It will enable you to make a complete check of the operation of the transmitter, including an exact determination of modulation percentage.

USING THE CRO

To obtain a picture of the wave envelope an oscilloscope with a sweep oscillator is required and also a source of audio signal.

Output from the transmitter is coupled to the vertical plates of the cathode-ray tube by means of a pick-up loop. The idea is to wrap a few turns of hook-up wire around the final tank coil and take the ends of the loop to the vertical plates of the oscilloscope and earth respectively. If the oscilloscope allows access to both vertical deflecting plates the ends of the loop should be connected one to each.

With the transmitter tuned to resonance and the sweep circuit operating the pattern on the screen will be as shown in fig. 2a. The vertical height of the pattern can be adjusted by varying the number of turns on the pickup loop while its width can be varied by means of the horizontal gain control of the oscilloscope.

ENVELOPE, TRAPEZOID PATTERNS

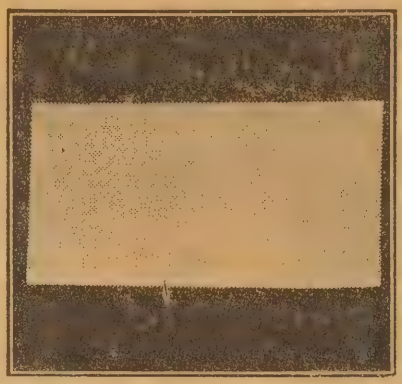


Fig. 2a. Carrier only.

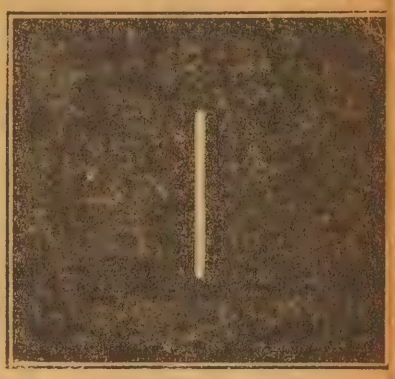


Fig. 3a. Carrier only.

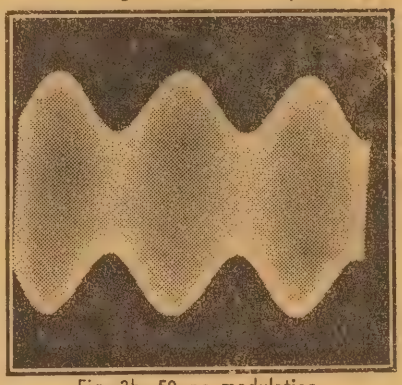


Fig. 2b. 50 pc modulation.

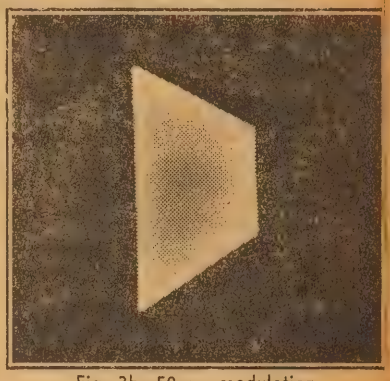


Fig. 3b. 50 pc modulation.

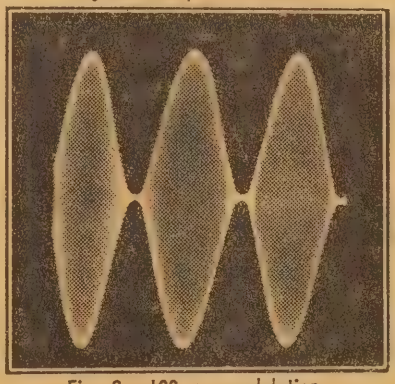


Fig. 2c. 100 pc modulation.

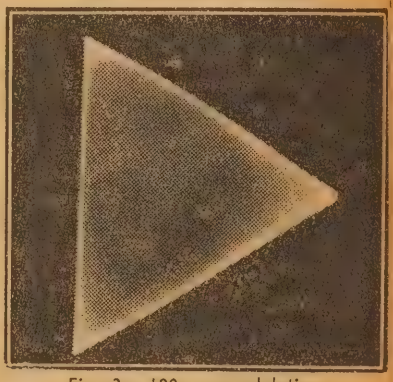


Fig. 3c. 100 pc modulation.

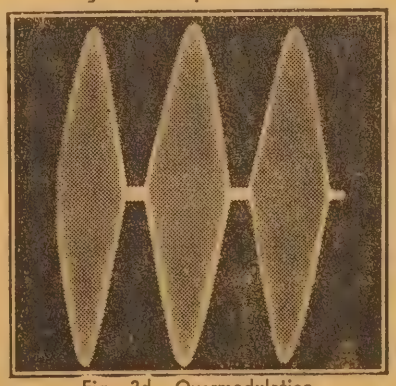


Fig. 2d. Overmodulation.

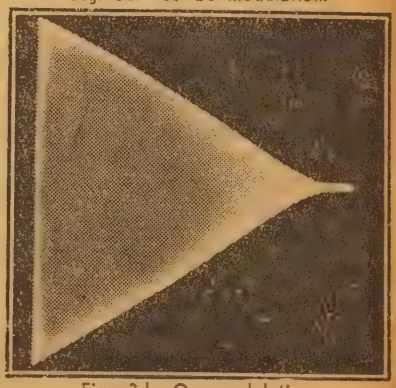


Fig. 3d. Overmodulation.

Before any further tests are made it is necessary to load the transmitter by the correct amount—in this case 50 mA. The most convenient way of doing this is to connect a lamp across the aerial terminals. A low voltage lamp rated at about 15 watts is most suitable for this purpose and may be connected to the normal aerial loop. The number of turns on the aerial loop should be varied until the PA draws the correct amount of current at resonance.

If you have only a 240-volt lamp,

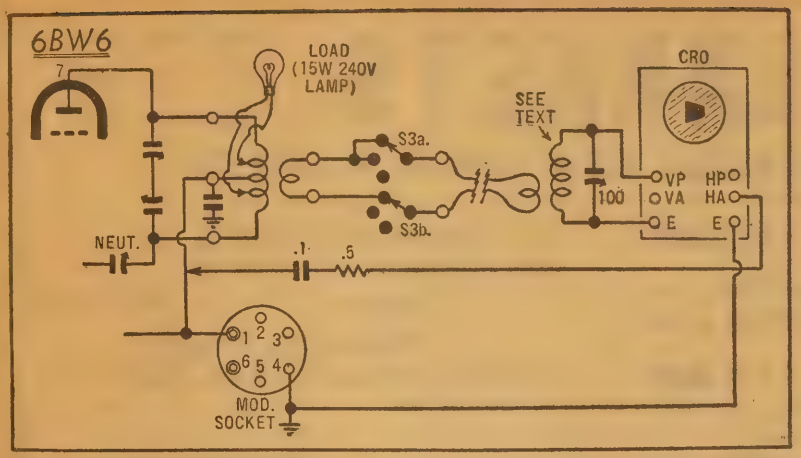


Fig. 4. Here is a good arrangement for obtaining the trapezoid pattern. Alternatives are discussed in the text. For the wave envelope pattern, the connection between the horizontal amplifier of the CRO and the transmitter is not required but a suitable audio signal generator should be fed into the modulator. The CRO sweep must be synchronised with the generator.

either 15 or 25 watt, this can be temporarily connected directly across the final tank coil, or half of it, if the former connection gives too high a degree of loading. The 240-volt lamps have such a high resistance that it is inconvenient to use a pick-up loop.

Another method of obtaining the RF to operate the oscilloscope is to provide a low impedance link between the transmitter and a tuned circuit which is attached to the oscilloscope. This is more satisfactory than the untuned link, especially in the case of an oscilloscope with a large screen, because it makes it very easy to obtain the high deflection voltage required without the need for a large coupling link. In addition it will discriminate against harmonics which may tend to confuse the pattern.

TUNED COUPLING

If you use this method, the lamp connected across the coil may still be used for loading.

In our case many of the tests were carried out on the 14 Mc band. The 28 Mc coil together with an old 100 pf variable condenser which happened to be around were wired together to form a tuned circuit which was easily able to tune to 14 Mc. With a one-turn link loosely coupled to it, there was no difficulty in obtaining the required deflection voltage, even for a 5in oscilloscope.

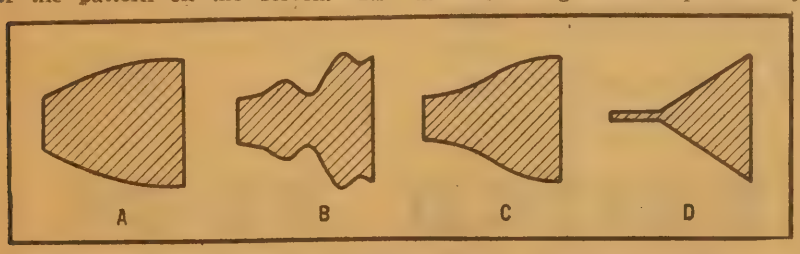
After you have succeeded in obtaining the pattern shown in the photograph of figure 2a, an audio signal may be fed into the modulator and the gain control advanced. You will note a change in the character of the pattern on the screen. Its exact nature will depend on the setting of the sweep circuit. The idea is to vary the sweep frequency until a stationary pattern such as that of figure 2b is obtained.

The modulation percentage can then be adjusted by varying the setting of the audio gain control. Figure 2b shows the carrier wave modulated 50 pc. In figure 2c the gain control has been advanced so that the carrier wave is modulated to almost exactly 100 pc. Note that in both cases the pattern has a smooth envelope and, in the second, the carrier wave is on the verge of being cut off on the negative half cycle.

When these photographs were taken, a pure audio tone from an audio signal generator was being fed into the modulator. If the input tone is impure, the modulation pattern will be altered accordingly.

Figure 2d shows the effect if the gain is advanced too far. You will note that the carrier wave is cut off completely on the negative half cycle, leaving abrupt corners instead of the smooth curve of the previous diagram. Each time the carrier wave is cut, interference is radiated on adjacent frequencies. The reason is just the same as in the case of the CW transmitter. You can see, therefore, that it is most important that 100 pc modulation be not exceeded during transmissions on the air.

An even more useful pattern for checking the operation of a phone transmitter is the "trapezoid." The set-up for obtaining this pattern is shown in figure 4. You will note that no auxiliary pieces of equipment are required. The oscilloscope need not even have a sweep oscillator, so that the arrangement is a particularly



Faulty oscilloscope patterns. (A) Insufficient drive to modulated amplifier. (B) Modulated amplifier unstable or oscillating. (C) Incorrect matching between modulated amplifier and modulator. (D) Overmodulation of otherwise correctly adjusted transmitter.

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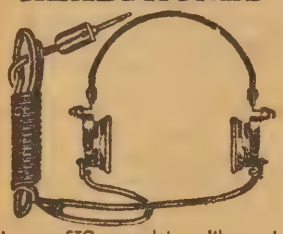

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useful one if you wish to set up a small cathode ray tube to monitor the modulation percentage permanently.

The arrangement for obtaining vertical deflection may be exactly as in the previous case, either a pick-up loop or a link-coupled tuned circuit being suitable. The horizontal deflection is obtained from the "hot" side of the modulation transformer.

There should be a suitable blocking condenser between the horizontal input terminal of the oscilloscope and the gain control, but if you are not sure, you can install one external to the instrument just to be certain. A .5 meg resistor makes it easier to obtain a suitable setting of the horizontal gain control, since the audio voltage available from the modulator is many times greater than is required for the input of the horizontal amplifier.

TRAPEZOID PATTERNS

With the transmitter switched on and no modulation, the pattern will be as in figure 3a. As the modulation is turned up, the pattern will change to that of figure 3b, assuming everything is in order. This corresponds to the 50 pc modulation pattern of figure 2b. The horizontal gain control should be adjusted to give a pattern of suitable width. Then, as the gain control is advanced, the pattern will change to that of figure 3c when the modulation is 100 pc.

If 100 pc modulation is exceeded, the pattern will change again to that of figure 3d. Note the thin line to the right of the triangle. In practice this line appears very bright on the screen so that it is easy to detect overmodulation at a glance.

One of the main advantages of the trapezoid pattern is that it is not affected by the frequency of the modulation. Exactly the same pattern can be obtained by whistling into the microphone. It is the more useful pattern for detecting small amounts of non-linearity in the modulated amplifier, but will not show up distortion in the modulator itself. The latter may only be shown by the wave envelope pattern described previously. With the oscilloscope set up it is very easy to try both.

The patterns so far described were obtained with our 17 watt transmitter in a state of correct adjustment. For your further information, we have included a set of diagrams to show the effects of incorrect adjustments.

AERIALS

Apart from a receiver, before you can go on the air you will require an aerial or aerials for the band or bands on which you intend to operate. The simplest approach is to put up a half-wave dipole for each band on which you wish to operate and leave it at that. If you have room for about three poles you can string several aerials between them to suit your requirements.

From the centre of each aerial a length of plastic lamp cord, or 75 ohm ribbon, if you are interested in best efficiency, can be run down to the transmitting position. Each time you wish to change bands you simply have to connect the appropriate aerial. The exact length of the feeder line is unimportant.

While such a system has the advantage of simplicity and allows an

(Continued on Page 104)

Here's your answer, Tom!

While many readers starting with radio as a hobby find it necessary to scrape and save to buy every new component, there are those more fortunate who are able to walk into a radio store and order "the works." Our "Tom" for this month is one of these lucky people, but perhaps there is something to be said for the scraping and saving approach as his queries will reveal.

OM was attracted by the description of a fairly large communition type receiver which was deribed in Radio and Hobbies a few ars ago. Armed with the necesry £sd he went into a radio supply ore and bought a complete set of rts, down to the last piece of aghetti and solder lug.

He had had very little experience th radio assembly before but probly, with the thought that painstakg work could make up for his lack experience, he went ahead with the o of assembly and wiring.

Despite his efforts the finished job oked very much like the work of an tidy spider and the performance as far from satisfactory. Being a rsonal friend of the writer, Tom me along for some help.

Which brings us to his first query:

"Spider's web"

What is the secret of good wiring?

Well, Tom, many of our readers art off by building a simple crystal ceiver and progress through the rious stages before they attempt ything as ambitious as a communition receiver. The various impornt points about wiring a set are cked up in the process.

But to get back to your query. he best guide to good wiring is a owledge of how the set operates.

In all receivers there are certain res which are used solely for the rpose of supplying power to the rious stages. The heater circuits in ur receiver are an example. The quirement is to run a pair of wires om the transformer to the filament ads of, in your case, about nine lves.

There is no special need to make ese leads very short and the best thing is run these leads in a neat line around the edge of the chassis where they will be out of the road and leave room for other components which have more claim to a place near the valve sockets.

Of course, don't make the leads excessively long, as this will result in needless voltage drop. Judgment in this matter comes with experience.

When the heaters are operated from AC it is good practice to twist the supply leads together so that the magnetic field around them is reduced to a minimum.

A little kink we often use is to twist a double length of hook-up wire with a pencil. Take a piece of hook-up wire and grip the two ends in the vice. With a pencil or a screwdriver hold the loop out tight and twist the two wires together just as you would wind a rubber motor of a model aeroplane.

You can then cut off the length of twisted wire you need to go from one valve to the next.

There really isn't any secret to it at all, Tom, it is just a matter of applying sound reasoning.

We can now anticipate your next query.

Which leads should be kept short?

As a general rule, leads which carry signal currents should be made short and direct. The layout of a well-designed receiver will have been planned especially so that these leads can be made short and in mounting valve sockets and coils you should make sure that they are the right way around.

GRID CIRCUITS

In many cases the wires from a coil to the grid circuit of the following valve can be run direct from the lug on the coil to the lug on the valve socket and made as short as possible. In IF and audio circuits where a little extra capacity is not too serious, it may help to keep the coupling between the inputs and outputs of successive stages at a minimum by running the wires close to the chassis.

We generally make a practice of installing all the important wires and components first. Less important wires and components are neatly fitted into the space that remains.

Wires that carry only DC supply for plates and screens can be cabled neatly with the heater wires. We generally use hook-up wire having seven strands of 0.01in diameter wire for the conductor and a plastic covering. For heater wiring 10 strand wire is a better proposition as it is able to carry a greater current without serious loss.

The plastic covering will soften if subjected to excessive heat but is quite satisfactory if you solder quickly and efficiently. For most joints it is satisfactory to remove about 1-8in of the insulation only.

Cathode and screen bypass condensers carry signal currents, so that these should be placed close to the associated valve circuit. In the interests of eye appeal, these components are usually laid out with their axis parallel to the ends of the sides of the chassis. In the case of IF and audio circuits it is often permissible to mount the bypasses and their associated resistors in neat rows on a terminal strip.

HIGH FREQUENCY

However, with high frequency circuits an extra inch or two of wire can be very important and the geometry of the layout often has to be sacrificed for efficiency. Once again, judgment only comes with experience.

If you had started with a simple receiver and proceeded along the well-beaten path by following our "Learn While You Build It" series, for example, you would have been able to pick up these points as you went along.

As it is, you will probably have to strip the receiver right down and start from scratch again. This time take particular care with the mechanical mounting of small components. Every resistor and condenser in the set should have both ends firmly anchored.

"A hot circuit"

If a group of components meet where there is no coil or valve socket lug, instal a tag strip or an ebonite pillar. It will take you many hours of work to make a good job of your particular set anyway, so don't be tempted to hurry.

I have heard mention made of

"hot" circuits in discussions on radio. What is meant by this?

This is simply part of the usual technical jargon, Tom, and doesn't imply that the wires are likely to catch on fire or anything of the sort. When a radioman refers to "hot" wires he usually refers to signal circuits, especially those that have to be treated carefully because they are handling low level signals.

In a slightly different sense a "hot" circuit is one which has some special feature or is especially efficient.

I have noticed that in technical articles you say that spirits should not be used as a flux for radio work. What is the reason for this and what sort of flux do you suggest?

Spirit of salt, or hydrochloric acid, to give it its chemical name, is an excellent flux for soldering galvanised iron and therefore is used extensively by plumbers. However, galvanised iron has a coating of zinc and the acid reacts with the zinc to form a very much less corrosive substance called zinc chloride or killed spirit. If spirit of salt is applied to copper or brass there is no rapid reaction and the acid remains active to attack other parts of the job being soldered.

STILL CORROSIVE

Even killed spirit will attack a soldered joint in time, and for this reason is not recommended for radio and electrical work.

Resin is a good flux for radio work. Solder in the form of a wire with a central core of resin is available and saves a great deal of time when wiring a receiver, where all the components are bright and new.

There are several excellent patent fluxes available in the form of a paste. Some are based on resin but have additives which help when there is a small amount of oxide coating present, but do not tend to attack the solder joint. Of course, the aim of a good workman is to have all wires and solder terminals perfectly clean before making the joint, but this is not always possible.

When wiring components that are not completely new and shiny we sometimes use a trace of paste flux in addition to the resin contained in the solder.

One unfortunate reader of Radio and Hobbies used spirit of salts as a flux when wiring a radio receiver. He made a beautiful job of the wiring: every wire in its proper place with neat right-angle joints and all the small components set up in neat rows on tag strips.

INEVITABLE RESULT

A few weeks after the set had been installed in its cabinet it began to develop noises and crackles, and on investigating the cause our friend found that every solder joint in the set was covered with corrosion, not to mention the chassis, which was rusted from end to end. Eventually, the set had to be stripped, the chassis repainted and all the small components cleaned individually.

Why is it necessary to use flux?

Apart from neutralising the oxide already present, Tom, flux will control oxidation of the surface being soldered occurring when the heat is applied.

You are probably familiar with the results when metals are exposed to the atmosphere in the normal way. Copper, brass, iron and other metals form a scale on the surface and this scale will prevent the solder from making contact with the metal beneath.

When the temperature of the metal is raised this oxidising action takes place much more quickly. In fact, it takes place so quickly that it makes it impossible to bring the solder in contact with the metal when the latter is raised to a temperature sufficiently high to melt the solder.

However, when a flux is used the air is not permitted to come into direct contact with the metal and the soldering operation can take place unhindered.

In addition to keeping the work chemically clean the flux helps to make the solder flow freely.

What is the significance of solder ratings? I have seen solder labelled 50/50, 60/40, &c. Can "plumber's solder" be used for radio work?

Ordinary solder is an alloy of two metals, tin and lead. The figures refer to the percentage of each contained in the solder.

For general purpose soldering 50/50, or solder containing equal amounts of tin and lead, is excellent. It melts at a tempertaure of 370 degrees Fahrenheit, so that it can easily be melted by applying a hot copper bit to the work being soldered. Most of the solder which is sold for radio work comes into this category.

Although somewhat more expensive, an even better solder contains 60 pc tin and 40 pc lead. This solder melts at a temperature of only 340 degrees Fahrenheit.

Coarse solder contains 60 pc lead and 40 pc tin, while plumber's solder contains 66 pc lead and 34 pc tin. These melt at 400 degrees and 440 degrees Fahrenheit, respectively, and because of this are frequently melted by means of a blow-lamp rather than the usual copper soldering bit.

DON'T TRY IT

While we do not wish to underestimate your skill with a blow-lamp, Tom, we suggest that a soldering iron is much more suitable for wiring radio sets!

You will note, then, that the better quality solders contain a majority of tin and melt at a lower temperature than solders containing a majority of lead. The solders containing the majority of tin find application in better-class work and fine work where the quantities required are not great.

Let's Buy An Argument

I've had considerable fun and games during the month, wading through the elements of color television. For those who like an argument, it looks like being a particularly fertile field. All the techno-psycho-physio-aesthetic aspects familiar in sound reproduction, are there in full force but related to the eye instead of the ear.

by W. N. Williams

AT the outset, I must confess, we approached the preparation of the current "Television" instalment with a certain nonchalance—typewriter in one hand, reference books in the other and a sheaf of copy paper in the other.

It rapidly became apparent that most of the "simple explanations" of color phenomena left a great deal to the imagination—and how those imaginations work!

On a more academic basis, there is sufficient conformity between the various systems of color reproduction—painting, photography, printing, &c.—to make comparison interesting. There is also sufficient divergence between their respective principles and practice to make for confusion—and does it confuse!

Take, for example, the fundamental question of primary colors.

We asked an artist. He said, quite definitely, "red, yellow and blue."

We asked a litho. expert. Said he, just as definitely, "Red, green and blue."

We asked a photographer. He said, "It all depends."

It transpired that one of the big American national magazines set out, some time ago, to analyse this very point for the sake of its many and varied readers. After the usual display of pretty diagrams, I am told, it succeeded only in perpetrating the error it set out to correct. That's what I mean.

Before you can begin to appreciate the significance of primary colors it is essential to make a clear distinction in the mind between the two steps involved in color reproduction:

(1) The original analysis of the scene by the photographic or the television camera, and

(2) The assembling of the ultimate color image for presentation to the eye.

As we have indicated in the television article, the color values involved in the two steps may be quite different, irrespective of how intimately they appear to be linked.

It would seem abundantly clear that the original analysis of the scene—whether by the eye itself or by the camera—is based on red, green and blue-violet images, these being the fundamental physical primaries.

They are, therefore, the primaries nominated as a matter of course by those concerned in any form of photo-analysis.

When it comes to assembling the final color reproduction, it is discovered that the eye sees color by two distinct processes, which we have defined elsewhere in the issue, namely "additive" and "subtractive."

SAME PRIMARIES

In the additive case the same three primaries are retained as for the original analysis, namely red, green and blue-violet.

For "subtractive" presentation the dyes or pigments have to be switched to magenta, yellow and cyan so that the eye can see from their mutations the full range of spectral and non-spectral colors.

Of course, it might will be contended that the artist came before the camera and the long-haired fraternity automatically has the right to nominate the "real" primary colors, even if in ignorance!

Perhaps this last phrase invites a retort, because the French Pointilliste school certainly did appreciate the difference between mixing pigments and placing them side by side as tiny individual dots of color.

However, such an argument about priorities and terms seems rather beside the point. The important thing is for all the interested parties to learn a bit of physics and come to appreciate why this-plus-this equals that.

Having got the basic theory straightened out, the next step is to see how closely it can be linked with everyday practice.

Yes, you can explain, without too much difficulty, how a loudspeaker works, but you have to go on to realise that there are all kinds of practical limitations on speaker de-

sign, which compromise the pure sound which should issue therefrom.

And there are likewise many limitations on the accuracy of any process of color reproduction.

Freshly armed with the neat theory about standardised color filters, I was to learn, for example, that color films allegedly do not use accurately color-sensitive emulsions. Instead they're supposed to be (I wouldn't know) fairly standard ortho and pan emulsions which are broadly responsive to the centre and two ends of the spectrum.

The ultimate dyes are not accurate subtractive primaries either, but compromise shades intended to compensate for the irregularities of the original emulsions.

Remember the equivalent audio story? The response of audio equipment gets pushed up or down by accident or design and you compensate in the amplifier by the reverse amount.

"Quite correct," says the engineer.

"Naughty, naughty," says the pseudo-purist.

As with sound, so with sight. One factor upsets the original scene analysis, so another is adjusted to compensate.

"Quite correct," says the chemist.

"Naughty, naughty," says the pseudo-purist.

So the game goes on.

MORE COMPROMISE

Next I visited a color printer, saw his array of cameras, his filters, his separation negatives. But I learned that he often worked only with two filters, leaving the natural sensitivity of the emulsion to pick out the third color. The explanation had something to do with exposure times.

He explained, too, that his inks were neither pure nor properly transparent, so that color mixing didn't follow the laws for pure colors. That's why, apparently, the three-color process, as far as the printer is concerned, often gets up to four colors with a couple of different blues and a black overprint, cost notwithstanding.

To cap it off, he pointed out that the dot-patterns in the half-tone principle had to be carefully controlled and registered.

In light areas, where the dots do not overprint, the colors tend to combine by the additive process. In dense areas the subtractive process predominates and the picture may well go "dirty," unless everything is very carefully controlled.

Even in an ordinary artist's painting, the same hybrid process of color mixing can go on, depending on the pigments and the surface texture.

SEVERAL FACTORS

The incident light can be reflected directly to the eye from the surface of individual pigment particles, giving an additive effect.

Alternatively, the rays may be reflected from one pigment particle to another before finally reaching the eye. This gives a subtractive effect.

To both must be added the qualities of the binder in which the particles are suspended.

I might well imagine one of the end-justifies-the-means types interjecting at this point. . .

"Who cares, provided it looks right? What's it matter whether you're looking at a mixture of magenta and yellow or just plain red? Or even all three? After all, the eye is the final judge!"

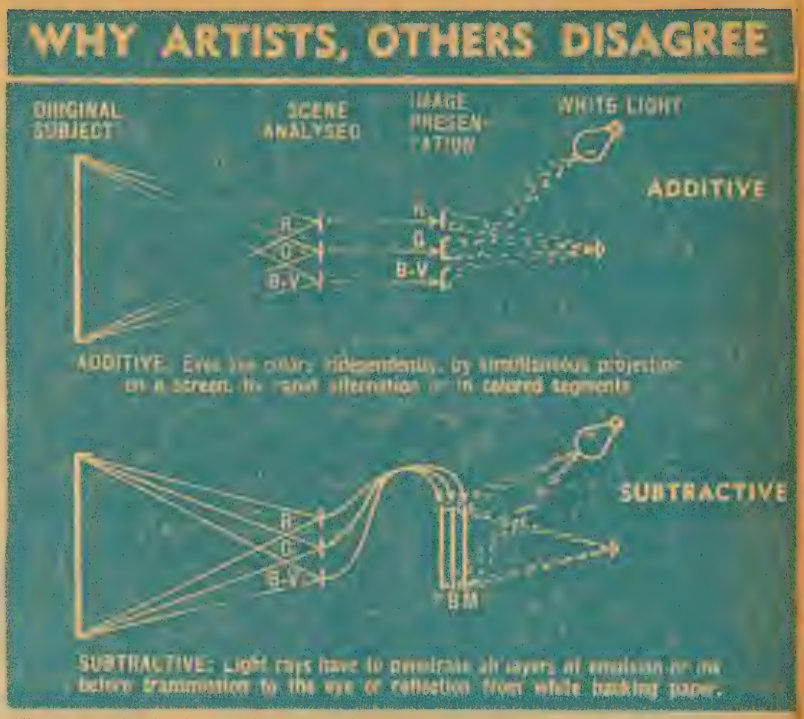
Now where have I heard that before?

Of course, the eye is the final judge but, like the ear, it's a remarkably tolerant one.

It will tell you two colors are identical when the shape of their spectral response curves is quite different. And because the eye can't always analyse colors accurately, neither can it predict—without a lot of experience and deduction to support it—how two pigments will look in combination.

After wading through all this, it's a relief to think that the color aspect of color television may be the simplest of all systems—just a plain, honest-to-goodness additive presentation of three different colors to the eye. That's just a small word of encouragement.

Of course, there are plenty of things to argue about other than hues.



Illustrating the fundamental systems of additive and substractive presentation. Though suggesting only incident lighting, the same is true exactly of transparancies or rapid sequential color presentation as in television.

What do you think?

AIR will transmit all manner of pressure waves, including those having a frequency between about 30 and 15,000 alternations per minute.

If such pressure variations happen to affect your ear, your brain receives a stimulus which you describe as noise. But can noise exist as such where no one is present to hear it?

The same goes for color—it is merely the stimulus which our brain derives from magnetic radiations of a certain wavelength. Can color possibly exist anywhere else but in the hidden recesses of the human mind?

There's the classic one levelled at technicolor and also images on ground-glass camera screens—"the colors are too bright."

It may well be that, in some cases, the image subtends at the eye a smaller angle of vision than the original scene, resulting in an apparently intensified color sensation on the operative receptors.

More than likely, however, it's just the viewing conditions which allow you to look at a sharply-defined and brightly-colored image in a region of otherwise deep shadow.

If you were to walk around the countryside wearing a large black hood and able to see only through a narrow angle out in front, something of the same effect might be obtained.

Then, again, with the theatre-house lights on, the technicolor image would "wash out" to mere pastel shades. With light under the hood, the ground-glass image would likewise soften and wash out.

AMBIENT LIGHT

In other words, our conceptions of brightness and contrast depend a great deal on ambient light and conditioning of the eye, just as our hearing reacts to prevailing noise.

Supply the eye with a precise combination of red and green, and it sees grey. Substitute precise proportions of blue and yellow, and it still sees grey. A dimly-lit white or a brilliantly-illuminated near-black in suitable surroundings will give the same visual reaction—the selfsame grey!

Put the grey into a brilliantly-lit patch of white and you begin to think of it as black.

A poorly-lit yellow is seen as brown, and so on, ad lib.

I know all this isn't very constructive, but it might at least indicate

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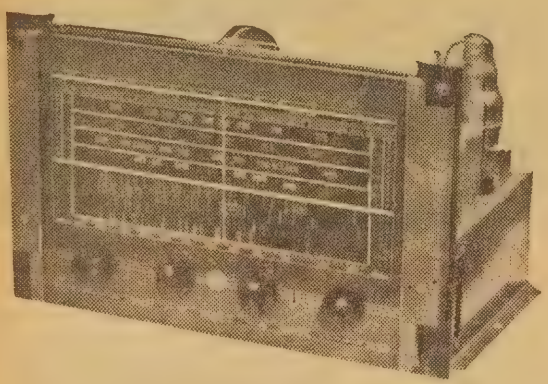

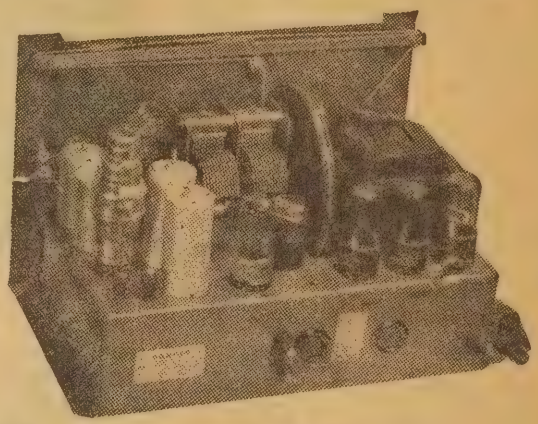

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that there's a lot to this color business. Before we're through, we'll be having a lot of discussion about compensation and tone controls—with a different interpretation of the word "tone"!

And all that, of course, omits completely any mention of color techniques, the sequential pictures, lines and dots, the flicker rates and a hundred and one other details.

Maybe color television might be a bit complicated, after all.

ABOUT FILMS

While speaking of color, I am prompted to express a few thoughts on another and entirely different subject.

In a mood of relaxation a couple of weeks back, I found myself in a local but very ambitious theatre, following the doings in one of the recent Hollywood musicals.

With the thought of color reproduction firmly in mind, I cast a critical eye on the screen, looking for imperfections. If there were any, I didn't see them.

The colors looked bright, as I have mentioned elsewhere, but there was no obvious "bias" to the reproduction. Countless times, through the film, the scene put magentas and orange-reds side by side with pure greens, pure blues, yellows, browns and just about every other color one could think of.

In one particular scene, hundreds of delicately-colored pastel balloons floated down from the ceiling, and they looked pretty much like colored balloons to me.

I must give the editors full marks, too, for their handling of the laps and fades, both in the picture and the sound-track. They used all the tricks, with never a beat or a syllable out of place.

It doesn't matter much at this stage whether you like Hollywood musicals or not. The point I am trying to make is that the picture was virtually perfect from the photographic and editorial point of view.

But the actual sound? That was another matter.

First impression was indeed very good. The frequency response was apparently quite wide, general balance good and voices perfect.

Then one of the painted heroes moved up to the lens and began to pour forth his heart in song. Up came the level, consistent with the camera closeup, and I found myself cowering in the seat waiting for the system to overload. It didn't quite, but the sound on peaks had that uneasy, restricted quality that indicated a gauntlet of peak limiters, audio AVC's, and every other like device known to man.

A few minutes later, milady decided to respond in similar vein, and this time the sound simply collapsed on peaks into a nerve-wracking, unashamed overload buzz.

Nor was the experience an isolated one. A few weeks previously I had to sit through a musical biography that distorted badly in sections—I tip throughout certain whole reels. It was pretty painful.

Now I know that you can blame film distortion on to bad prints badly-adjusted projectors, faulty amplifiers, poor theatres and injudicious operators. They all play their part in compromising the result, but I'm concerned with the result.

I may be peculiar, but I seem to be developing a complex which makes me uneasy every time a robust character looks like singing. I seem to expect distortion—and most times I get it.

In the old days, of course, it was simply wonderful to have sound at all. To hear the engine puffing, the gun shooting—even understand most of what the characters said! That was really something.

After they cleaned up the "bugs" a bit, film reproduction emerged as just about the best system in everyday use, with the frequency range of discs but none of their horrible scratchings. Since then we've come a long way . Tape and microgroove have beaten the noise problem and greatly widened both the frequency and the dynamic range. We've grown used to wide-range speakers in our own homes.

But the film man is still battling to keep the noise down and the dynamic range up. He has to face all kinds of difficulties arising from the photographic transfer as well as the hazards of projection in thousands of theatres.

Provided he can follow the usual technique, boosting whispers and trimming shouts to keep the dynamic range down, all is well.

NOT ADEQUATE?

But it seems to me that the sound system just isn't a match for the occasions when situation and picture demand an exultant crescendo of sheer volume. It hesitates, it mucks about, it overloads—and I cringe in my seat.

But, as I said, maybe I'm peculiar. Maybe I'm the only one who is so affected. If so, the exhibitors can cease to quake.

Then, again, I mightn't be peculiar. Maybe others feel the same way. If that should be the case, there's only one possible answer. The film will have to find a simple way of greatly expanding its dynamic range, otherwise the sound-track will become a Cinderella in this modern age of canned amusement.

ABOUT HEARING AIDS

THOSE who may have been expecting this month more about hearing aids need not conclude that the subject has no sooner been raised than dropped again.

As I have explained on previous occasions, there is hardly time for correspondence arising from one issue to be received and sifted before the next is overdue for the printer. Some expressions have come to hand, however, which will receive due mention, probably next month.

One Queensland reader, for example, welcomes the idea of a hearing-aid discussion, although his remarks about alleged marketing methods would seem to call for a Royal Commissioner, rather than a humble technical editor.

Another reader (who doesn't happen to be deaf by the way) scouts my whole idea of an AC operated hearing aid and guffaws loudly at the stereoscopic problem. One of us must be on the wrong foot.

Write in by all means and don't for goodness sake be hesitant to argue—like one reader who concluded that "you always seem to be right." Even my own mother doesn't believe that!

FROM THE SERVICEMAN WHO TELLS

This month I have another piece of test equipment to describe and a couple of case histories which, while interesting in themselves, are also interesting for the circumstances in which they came to me.

VE have just about reached the end of our story on typical test nstruments but, before I fade this neme out completely, there is one nore unit I want to mention. It is nly a simple device, probably one f the simplest, and therein, no doubt, es its major advantage.

I am referring to the multi-ibrator, a form of signal generator hich requires no tuned circuits, no witches and, in fact, does not even equire calibrating. In case you are ondering what it is all about, per-aps I had better start at the be-inning.

A multivibrator is fundamentally low frequency oscillator, working t only a few hundred cycles, but designed that the waveform is adly distorted and so produces an lmost unlimited number of har-ionics.

The actual number will depend to ome extent on the design of the nstrument and the type of valves sed, but it is not difficult to pro-uce signals from the low end of he audio band, through the IF and roadcast band, and even to the high nd of the short wave band.

AMPLE RANGE

Usually there is still a bit to spare nd simple modifications can extend to something like 100 megacycles, ut this range is not likely to be eeded in ordinary servicing, though might be useful in the ham shack your leisure hours are spent that ay.

There is, of course, a catch. Such simple generator, while it produces what is virtually a continuous signal, is not capable of producing identifiable signals as in the case of the more conventional signal generator. For this reason it cannot, in any sense, be regarded as a substitute for the conventional unit, but rather has a few little specialised jobs of its own.

These jobs may not even occur very frequently, but the low cost of the unit makes it the type of thing which any serviceman can afford, paricularly as most of the bits will no doubt be available from the junk box.

Main use of these devices is for the adjustment of the oldtime variable padder condenser and, while some may argue that these are no longer popular, there are still a very large number of sets using them and, because of their age, they are more likely to find their way into a service shop than a modern one.

PADDER ADJUSTMENT

When adjusting these padders with the conventional signal generator, it is necessary to retune the set after each adjustment in order to compensate for the shift in local oscillator frequency. Alternatively, one could shift the signal generator frequency and leave the set tuned to the one spot, but this is seldom convenient in practice.

But the multivibrator does this automatically, simply by providing so many signals side by side that detuning from one immediately selects another until, eventually, one is found which corresponds to the resonance of the aerial tuned circuit. This is indicated by a simple peak as the padder is screwed in or out, and the tedious time-consuming ritual of adjust, retune, and measure, is avoided.

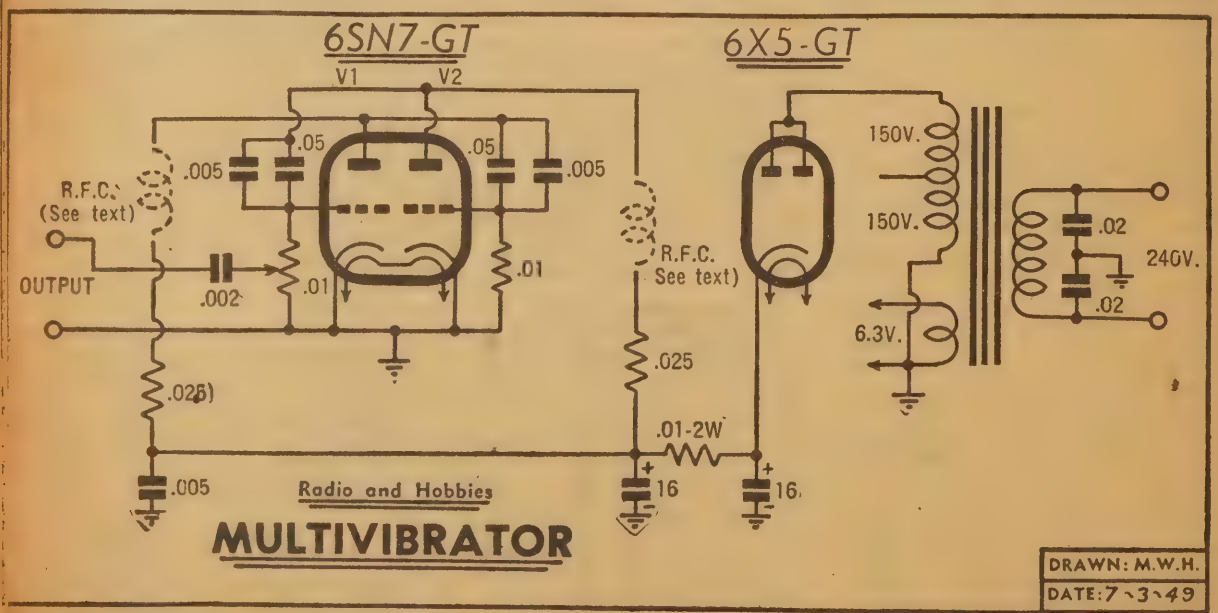
Thus the whole process of adjusting the padder is reduced to a simple peaking operation which is identical, as far as the operator is concerned, with that of adjusting the trimmers on the gang or IF transformers.

If your percentage of old-time sets is anything like average, the device will probably be justified on this score alone, but it is not the only job it can do. Used as source of signal for alignment it is often quite adequate and very much quicker than setting up the signal generator for the various frequencies.

QUICK ALIGNMENT

Admittedly such a procedure is not as accurate as that using a standard generator, but there are many cases when it is fully justified. You have probably all encountered the case where an owner has indicated that he wants to spend an absolute minimum on repairs, generally when the set is a fairly old one, and simply requires that the major fault be repaired rather than the set be given a complete overhaul.

You can, of course, take him at his word and simply replace the resistor, or whatever it is, without giving any further attention to the overall performance. However, if one or two tuned circuits are badly out of tune this can be improved markedly by

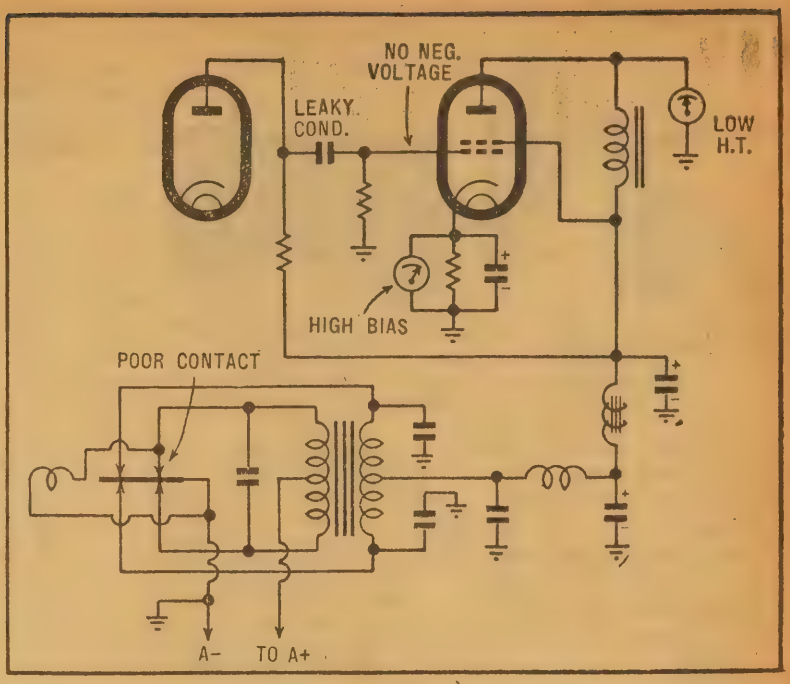


Only a handful of components are required for this instrument and many of them may be salvaged from the junk box. Voltages are not particularly critical and almost any type of transformer may be pressed into service. Construction details can be left to the individual.

even a rough and ready alignment, and one is always tempted to check this point, since an improved performance if it does not increase the cost, is bound to please the customer regardless of what he may have said.

In such cases a good compromise is to simply "touch up" the various adjustments while the set is tuned to a local station and, while academically leaving much to be desired, it can often result in a worthwhile improvement in performance, even though there is no guarantee that it is optimum.

The same procedure, but using the multivibrator as a source of signal, will take no longer but will generally be a better job, simply because it is easier to judge the level of a constant tone, as against a program, while you can use an output meter if you really want to. Where this forms a part of the universal speaker system it will be present automatically and makes



A faulty vibrator contact and a leaky coupling condenser were the two major faults in this circuit, the latter causing abnormal HT and bias voltages. Other types of vibrators use separate contacts for the reed.

an even stronger case for the multivibrator.

Another feature of this device is that the output, over any one band, may be regarded as essentially constant, thus providing a simple means of checking the relative sensitivity of a set from one end of the band to another. To do this it is only necessary to feed the signal into the aerial terminal and sweep the dial from one end to the other, when any appreciable drop in sensitivity will be immediately apparent.

As far as I know these devices are not generally available comercially at least not in a form which would suit the serviceman and in view of their simplicity, most people would prefer to make their own. I understand that the Editor has a suitable circuit which he can publish and which should provide all the information necessary for the experienced builder.

BACK TO WORK

And now for some cases.

Have you ever noticed that the more you delve into some sets the more you seem to find wrong with them? A set I had recently was a case in point, there seemingly being no end to the job.

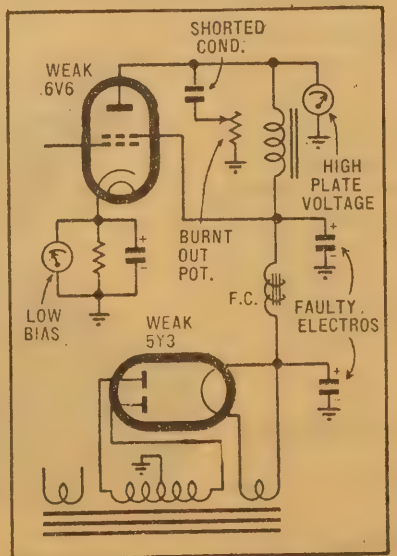
It all happened when the set failed and the owner decided to tackle the repairs himself. First thing he noticed when he removed the chassis from the cabinet was that the glass of the 6K8 convertor was loose in the base. "Ah!" thought our friend, "this is the trouble" and immediately hied to the nearest radio store for a new 6K8.

It transpired that the only available type was a 6K8-GT, which the salesman assured him was identical, electrically, with the 6K8. In this he was perfectly correct, but our friend found that, when the valve was plugged into the set, the grid lead would no longer reach the grid cap. Followed much mental abuse of the salesman while a short length of wire was obtained (ordinary citizens do not have junk and scrap wire boxes as a rule) and the necessary extensions made to the grid lead.

But alas, it was to no avail; the set refused to work. Our friend scratched his head and surveyed the chassis again. This time the rectifier caught his eye. Hadn't he read somewhere that rectifiers should not give out a blue glow? Well, this one was very blue in the face so it MUST be the trouble.

Another trip to the radio store, another new valve, and then back to the set to see if this diagnosis was correct. With the new valve plugged in the set showd signs of life and when a couple of stations had been tuned in our friend considered the fault cured and proceeded to replace the set in the cabinet.

This particular cabinet was not the



Even after the owner had effected some repairs there was still plenty to be done to this set. Note how the effect of a weak output valve is reflected in the operating voltages. Rewiring the tone control to the HT line reduced some of the voltage strain across the condenser.

easiest to fit, so it came as something of a shock when the job was done to discover that the set would only receive four local stations at the high frequency end of the band.

It was such a shock, in fact, that our friend decided to give it best. Far better to cut his losses at this stage and confess all to someone who knew what it was all about. Which is where I came into the story.

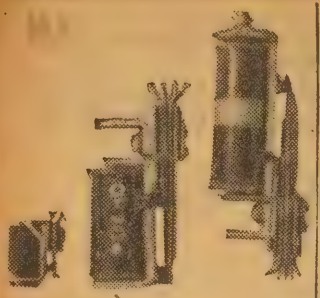
It did not take long to establish that the loose base on the 6K8, like Gilbert and Sullivan's "Flowers that bloom in the spring tra-la," had nothing to do with the case. It, presumably, had simply been put there to trap any non-technical owner who had ideas about repairing his own set.

In the matter of the rectifier valve our friend had been nearer the mark, for the old one really was faulty and the main reason why the set had failed. The story might have ended there if he had been a little more careful in removing and replacing the chassis and while he was extending the grid lead. As it was he had made an excellent job of bending the outside moving plates of the oscillator section of the gang, with the result that the thing was shorted from about the half-in position onwards.

SEVERAL FAULTS

With the plates straightened the set functioned more or less as it had before it failed. But it was clear that this performance was nowhere near that intended by the original designers. There was quite a merry hum in the output (the owner hadn't noticed it until I pointed it out) to say nothing of some distortion and general lack of bass response. As I noted the last point I more or less subconsciously tried the tone control —and found that it didn't work either.

Back at the shop I first measured the HT voltage. It was 270 which was rather on the high side for this make of set and, furthermore was hardly consistent with faulty electro-



AMERICAN RELAYS

No. 1 Miniature relay 300 ohm coil, S.P.D.T.: contacts, 7/6
No. 2 Standard relay 250 x 250 ohm coil 4 pole S.T. 7/6
2 pole S.T. 6/6
No. 3 Standard relay 15,000 ohm coil, 2 pole D.T. 12/6
All relays suitable for rewinding.

DEPENDABLE GENEMOTOR

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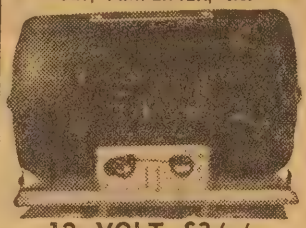

12 VOLT £3/-/-
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Type "A" Input 12V at 4 amp. Output 225 volts at 120 mA.
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Input filter supplied free with each genemotor.

CONDENSER SPECIAL

Well known make of new paper and electrolytic pig-tail condensers at half normal cost. Box containing six of each of the following capacity:— .005/600V, .01/600V, .05/400V, .1/400V, 10 mfd 40V, 4 mfd 600V, 8 mfd 525V, 20 mfd 525V.

50 CONDENSERS

70/-

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PILLO-FONE EXTENSION-UNIT

IT'S A REAL MINIATURE WITH ROLA UNIT
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Complete with 7193 valve, ready to use. Tuned by a split stator condenser worth this amount alone. An excellent driver for your 144 m/c Transmitter. Alternatively modulate the unit as it stands.

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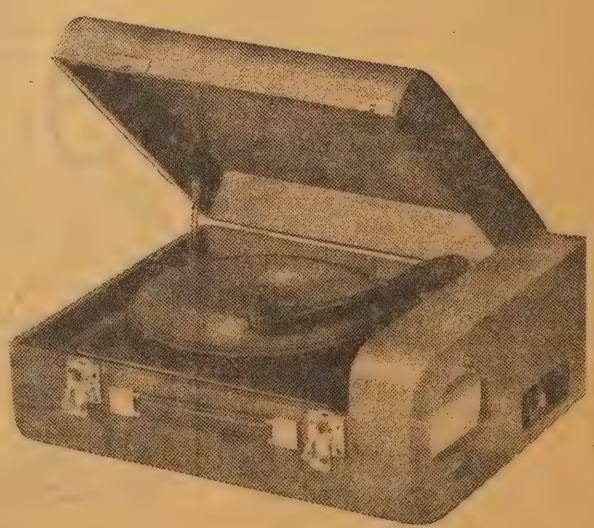
METROPOLITAN RADIO

479 PARRAMATTA ROAD, LEICHHARDT, N.S.W.

L.P. MICROGROOVE RECORD PLAYER

Portable record player complete with amplifier and speaker fitted with the popular B.S.R. type G.U.4 three speed motor and crystal pick-up with turn-over head. The whole unit being fitted in an attractive leatherette covered cabinet with spring handle and clips. Heavy duty speaker transformer and switch provide for the use of external 12in speaker for home use giving you the volume and high fidelity tone of an expensive radiogram.



£27/10/0 PLUS FREIGHT

£22/10/0 with single speed Garrard or Collaro unit

12in speaker with plug and cord 75/- extra.

CLASSIC RADIO

245 PARRAMATTA RD. HABERFIELD. PHONE UA2145

lytics which I suspected as causing the hum. Nevertheless, it was the electrolytics, and a new pair smoothed things out nicely. The only snag was that the HT voltage was now around 330, an increase which just could not be ignored.

Voltages of this order usually indicate that the current drain from the power supply is well below normal and the most likely single cause is the output valve, either because the bias is incorrect or because it has seen better days. On the assumption that the latter was more likely, I plugged the 6V6 into the tester. Result: Approximately 25 pc emission.

A new 6V6 brought the voltage down to just below the 260 mark and at the same time eliminated the distortion. There was quite a contrast between the performance now and the thin, hum riddled, reproduction which it had replaced.

MODIFIED CIRCUIT

Finally, the tone control. It was a conventional arrangement consisting of an .05 mfd. condenser in series with a 50,000 ohm pot. and all from the 6V6 plate to chassis. Measuring the pot. with the ohmmeter showed an open circuit and measuring the condenser, also with the ohmmeter, showed why—it was a dead short.

Out of curiosity I removed the pot. cover and found that there was little left of the element but a charred mass which, after all, is not surprising considering the current which would be flowing through it. When I replaced both components I took the precaution of wiring the network between the plate and HT line rather than the plate and chassis.

In this way the voltage stress across it is limited to the peak AC voltages whereas, in the case of the chassis connection, it can equal the DC voltage plus the positive peaks and, as these can equal the DC voltage, the total can be double the DC voltage. In addition, the DC voltage is present the whole time the set is running, and this steady application of voltage can cause local heating due to slight leakages in the condenser, causing in turn greater leakage and ultimate breakdown.

All these repairs, plus a routine alignment, resulted in a performance which was a far cry from that which it had given when I first came upon the scene. As usual, the owner had completely forgotten what the set sounded like when it was new, and would have been easy to convince that it was "better than ever."

Actually, the whole thing had left him a little crestfallen, for he was left with a spare 6K8 on his hands, had spent a lot of his own time "fiddling" with the thing and, finally had been made to realise that, even at the best, his attempt at repairs would have fallen far short of what was required.

CAUSTIC COMMENT?

All of which, I suppose, invites some kind of caustic remark about people not fiddling with things they don't understand, which is probably right, but the big snag is to convince many people that they really do not understand these things.

Anyway, why should I worry?

Another interesting case was one which came to me one Friday afternoon just prior to a recent holiday period. It was a car radio and, according to the owner, it had just failed and "was there any chance of getting it fixed that afternoon?"

As I had a couple of portables to finish and which had a similar priority I said I would do my best, but suggested that considerable time could be saved if he could take the set out of the car for me. To this he readily agreed and spent the next half hour or so curled into awkward shapes on the floor of the car and trying to find spanners which would fit the various nuts and bolts.

When he finally dumped it on the bench I had things sufficiently sorted out to enable me to at least give it a quick once over. It was obvious, as soon as the battery was connected, that the vibrator was not working but it took a little more probing to find out why. It was a rather old type cartridge and of a type with a rather unconventional reed contact system.

Most cartridges work on a simple series principle (similar to an ordinary buzzer) where the circuit to the energising coil is completed through a set of contacts which are normally closed but are opened when the reed is attracted to the coil.

Other types, of which this was one, connect the coil between the reed and one of the main primary contacts so that current flows through the coil when the reed is at rest, but is short circuited when the reed is attracted to the coil and the contacts close.

In this case the trouble was simply poor contact between these two contacts so that the reed was attracted to the coil permanently with no chance of releasing itself and vibrating.

EMERGENCY REPAIR

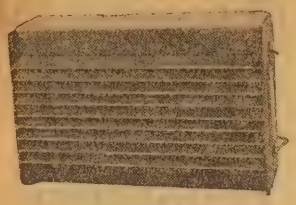
In the normal way high resistance between contacts causes considerable heat and will eventually draw the temper of the spring metal on which the contacts are mounted. When this happens there is not much future in trying to effect repairs for, even though the surface of the contacts may be restored, it is virtually impossible to retain the correct spacing which is vital to the successful operation of the device.

However, in this case there did not seem to be much help for it. I had no replacements of the type in stock and there was certainly no chance of getting one in the short time available. On the other hand, there was no evidence of heating around the contacts, mainly due to the fact that the circuit was completely open and that the unit had failed completely, and it seemed reasonable to suppose that a repair would give satisfactory service for a few weeks at least.

A carborundum magneto "file" was used to "dress" the contacts, after which the unit seemed to work as well as ever and the set showed signs of life. However, the voltage was rather on the low side while signals were rather badly distorted. Voltage across the output valve bias resistor was abnormally high, indicating excessive plate current and, in turn, suggesting positive voltage on the grid.

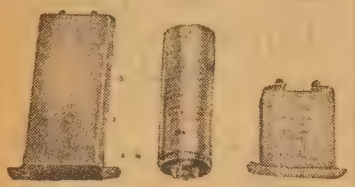
This suspicion was further confirmed by a complete lack of any negative deflection when the meter prods were placed between cathode and grid, although it appeared immediately I shorted the plate of the driver valve to the chassis with a screwdriver. The culprit was obviously the coupling condenser which had gone leaky. When this was removed, the HT and bias voltages re-

(Continued on Page 75)



Speaker Boxes

Attractive metal boxes with louvre front will take up to 7 inch speakers, suitable to hang on wall or use on table. Easily worth 35/-. **Our price 18/9.**



Block Condensers

(ex British Navy)

We have stocks of the following condensers. The quality is very good and nearly all were originally made for the British Navy.

Capacity	Voltage	Price
.005	2500W	2/- ea.
.02	300W Mica	1/6 „
.02	8000W	3/6 „
.03	5000T	3/- „
.1	800T	1/- „
.1	1500W	3/- „
.1	2000W	3/6 „
.1	4000W	4/6 „
.25	2000T	2/- „
.25	2500T	2/6 „
.25	2000W	4/- „
.5	500W	1/6 „
.5	2000T	2/9 „
.5	8000T (Oil filled)	4/6 „
1	500W	2/- „
1	500T	1/- „
1	800T	1/3 „
2	500W	3/6 „
6	400W	6/- „
	Electrolytic Condensers.	
16	450W	2/6 „
30	100W	2/3 „
50	50W	2/- „
80	100W	3/ „
500	15W	2/- „

Specials Specials

Spintites available to suit 1/8", 5/32" and 3/16" Whitworth hexagon nuts and with wooden handles. **Our price, 4/6.**

Flexible, similar to above, but with flexible shaft. Just the thing to get into that awkward spot, available in 1/8" Whitworth. **Only, price, 6/6.**

Indicator Knobs to fit ordinary ¼" shafts, black, less grub screws. Price, **3d each; 2/- doz.**

Dry Metal Rectifiers. Selenium 2 amp. rectifiers suitable for building battery chargers, suitable for up to 18 volts. Our price **only 39/6.**

Aerial Wire. Well known make of 50ft coils outdoor aerial wire, brand new and boxed. Usual price, 5/-; **Our price, 3/3; or 35/- doz.**

100ft coils outdoor **Aerial Wire,** usual price 6/6; **Our price, 4/9;** or **45/- doz.**

Push Back Wire, available in 6 colours. This is a well known make of English wire. In 100 yard rolls, the normal price is 6d yd. **Our price 30/- 100 yds.**

Shielded Coils. Aerial R.F. and Oscillator coils available in square metal can will match AW.A. or H. gang condensers. Normal price, 7/6. **Our price, 3/6 ea.**

2 Gang Condensers. 7 plate, 2 gang condensers. Capacity .0001 suitable for short-wave receivers. Worth 19/6. **Our price 4/6.**

Magneto Coils. One of our best sellers over recent months. Ideal for the experimenter, can be used as spark coil in motor cars, may be suitable for H.T. supply for oscilloscope and has many other uses. **Our price, 4/- each.**

Switches

Aircraft Magneto Switch. Metal cased twin single pole switches that will carry heavy current. Easily worth 7/6. **Our price, 2/9.**

Cutler Hammer Aircraft Switches. An extremely popular switch with Nickel-plated toggle suitable for any low voltage work Single pole, two-way and spring loaded single pole available. **All at one price, 2/- each.**

Semi - Rotary Bakelite cased switches suitable for 240 volt AC. A standard shaft radio knob will fit this switch. Easily worth 4/6. **Our price, 2/-.**

Yaxley 3 x 3 wafer switches. Usual price 11/9. **Our price, 3/6. Oak Type,** 7 pole 3 position. **Our price, 2/9.**

Oak Switch Wafers.
3 pole 3 position, **1/- each.**
6 pole 2 position, **2/- each.**

Switch Panel (illustrated): Consists of two triple toggle Switches and 3 Single Toggle Switches all in solid bakelite case with N.P. toggles. Also four push-button switches made of bakelite. All switches are suitable for voltages up to 32 D.C. and will handle up to 20 amps.
Price of complete panel, 10/6.

Push Pull Switches. Single Pole Switches suitable for low voltage only. Fitted black bakelite knob these are very popular. Normal price 3/6. **Our price, 1/3.**

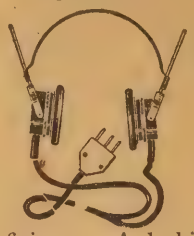
Micro Switches. Many different types available. **All one price, 6/6.**

NOTICE

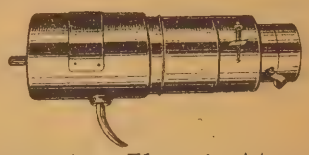
All parcels sent Registered Post unless otherwise stated.

Postage or Freight must be included with all orders.

Adjustable High Impedance Headphones



Made in Germany and brand new these phones have 4,000 ohms impedance and can be adjusted in a few seconds for maximum output and efficiency. A locking arrangement will then hold them in this position indefinitely. Ideal for Crystal Sets, small Valve Sets or any other purpose. This is the finest headphone we have had for years. Easily worth £4/10/-. **Our price, 39/6.**



Reversing Electric Motors

A light weight 24 volt motor suitable for rotary beam aerial control, etc. The gear ratio is extremely high and a brake automatically holds the motor in any desired position. Just the thing for the radio amateur. We are sacrificing this line for **£3/19/6.**

Remote Control for Car Radio

Consists of a Bakelite underdash mounting dial with tuning volume and tone control knobs. Square glass scale marked in kilocycles from 550 to 1600 Kc and also two flexible remote control cables approximately 2ft long. Could be adapted to any car radio.
Normal price, £6/10/-. **Our price, £3/19/6.**

English Low Impedance Headphones

Ex British Army, these phones are brand new and very solidly constructed and reliable. Suitable for telephone use, and for valve radio sets, etc. Easily worth £2/10/-. **Our price, 17/6.**

M/S MOTOR SPARES LTD. 547 ELIZ. ST., MELBOURNE

TRADE REVIEWS AND RELEASES

SPOT FREQUENCY GENERATOR FROM Q-PLUS

R. W. Steane and Co. Pty. Ltd., makers of the well-known Q-plus products, have just released a spot frequency alignment oscillator intended to provide alignment facilities for a minium outlay.

The device is a single frequency generator set by the makers to the now almost universally adopted intermediate frequency of 455 Kc. It is designed around a 3S4 valve and derives its power from two 4.5 volt torch batteries. Modulation is provided by means of a squeeging circuit and is set to approximately 400 cps.

It is intended to provide alignment facilities for those who do a limited amount of work and who may not feel justified in investing a large sum of money in a more elaborate instrument. In spite of its modest design, however, it is still capable of doing the most important job in the alignment of any set—the correct adjustment of the intermediate channel.

Once this has been accomplished it is relatively easy to complete the alignment by using signals from broadcast stations, and tracking troubles, &c., becomes relatively easy to trace since they will be confined to the oscillator circuit and associated padder and slug adjustment.

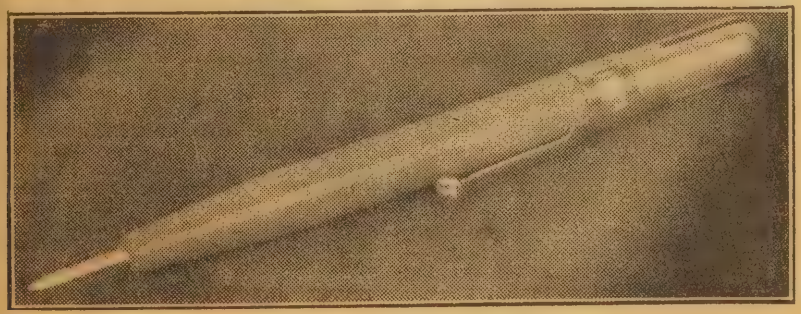
The unit also has the advantage of small size and light weight, making it ideally suited to the serviceman for work in the field where the bulk of the conventional instrument is often inconvenient. Independence of the power mains is another advantage while the operating cost of the batteries, under normal conditions, would be negligible.

Price, complete with lead and instructions, is 75/- plus 12½ pc.

☆

The Q-Plus spot frequency oscillator which provides an accurate 455 Kc signal for intermediate channel alignment. The unit is completely self-contained, power being obtained from internal batteries.

LUMOLITE POCKET NEON TESTER



Wm. J. McLellan and Co. Pty. Ltd. announce that they have been appointed agents for the Lumolite range of neon products and that the first item to be released is a robust moulded screw-driver which incorporates a neon indicator.

The unit has many uses for the serviceman, electrician and hobbyist. To use the device it is only necessary to hold it by the metal cap surrounding the neon lamp and apply the other end. The neon lamp will glow when in contact with active leads having a potential from 100 to 250 volts.

As well as indicating the presence of voltage it will also indicate whether it is AC or DC.

One of the most valuable aspects of a device of this kind is that it encourages safe working techniques by providing a simple but reliable means of checking any circuit on which work is to be done.

Retail price of the unit is 16/-.

CHANGE OF NAME

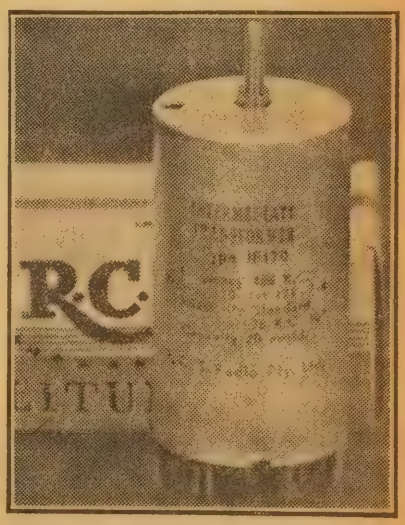
Philips Electrical Industries of Australia Pty. Ltd. announce that as from the 1st May, 1952, the name of the company has ben changed to Philips Electrical Industries Pty. Ltd.

The company wishes to emphasise that this change does not indicate any change in the structure of the company, but has been made purely to shorten the company title.

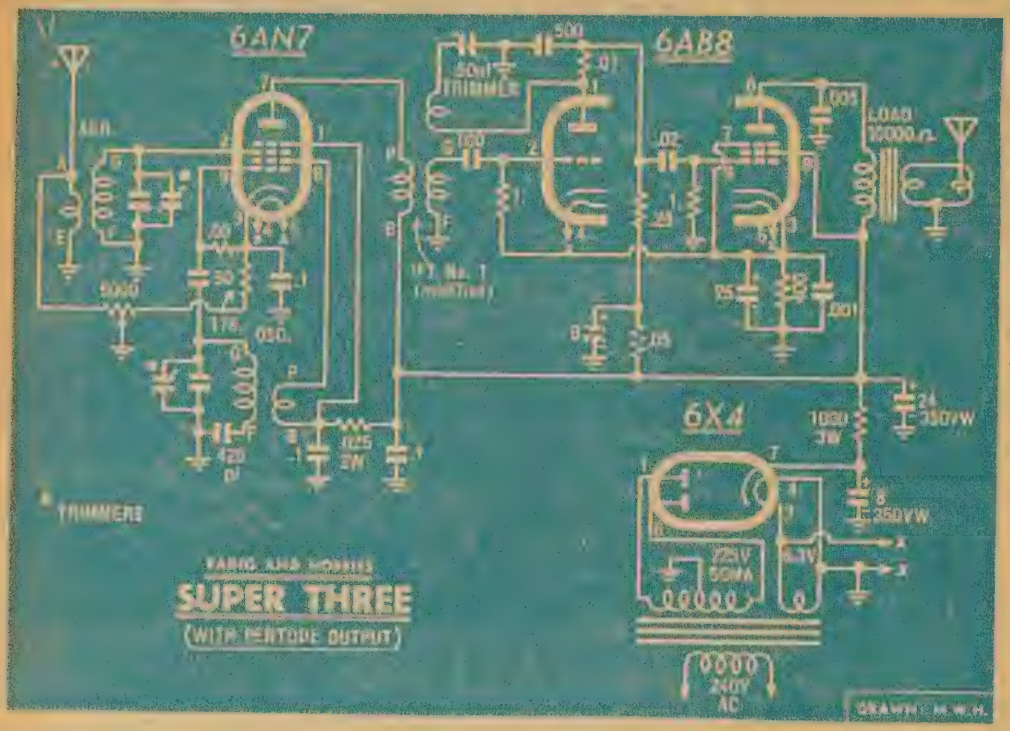
SPECIAL IF FROM RCS

The latest component release from the RCS factory is an intermediate transformer designed for use with small mantel receivers of the same general type as in the "Super Three" described in last month's R & H.

This will be welcome news to those who are interested in building this type of set but who may be a little diffident about modifying a standard transformer to accommodate the extra winding. The general construction is similar to that used for the "Super Three." On test in our original chassis, the transformer gave excellent results.



PENTODE OUTPUT FOR SUPER-3



This modified circuit of the Super Three shows all the wiring alterations and changes in component values necessary to accommodate the new valve. Note the modified power supply which virtually hum-free operation without the need for a choke. The dotted components may be omitted if hum requirements are less critical. The front end of the set remains exactly as before.

Since we described the Super Three in last month's issue, limited quantities of a new valve have appeared on the Australian market, and we were immediately struck with the possibility of using it as a substitute for the ECC33. For those who would like to build this version we are detailing the various circuit changes involved.

THE valve is an imported type known as either the 6AB8 or the ECL80, and consists of a triode voltage amplifier and output pentode in the one envelope, having a common cathode but with all other connections brought out to separate base pins. The base is a miniature 9-pin.

Although intended originally as a combined line oscillator and frame output valve in television receivers, its characteristics are such as to make it ideally suited to replace the ECC33 twin triode originally specified, having a greater power output (1.4 watts) and a lower HT voltage requirement (200 volts), the latter making possible a more efficient filter system at little extra cost. There is also some improvement in voltage gain, but this, while useful, does not represent any major improvement over the previous design.

ORIGINAL CIRCUIT

In fact, the original design must still be regarded as basic, and those who have already built it need have no fear that it is rendered obsolete by the advent of the new valve. Neither would we advise scrapping the ECC33 set-up in a receiver that is already built, for the difference would hardly justify it.

We do think, however, that those who are contemplating construction may well consider this valve a more logical type. In the event of a commercial version of our "Super Three" being produced—and there is a rumor that this may happen—it is likely that this valve will be the one chosen.

So much then for the general picture. Now to get down to the constructional modifications.

Although there is a miniature socket-hole already punched in this chassis alongside the larger hole used for the ECC33, we resisted our initial temptation to use it, and provided, instead, a small aluminium plate to carry the miniature socket in the original position.

Main reason for this was to avoid lengthening leads which are inclined to be critical, particularly those in the detector circuit. It also avoids locating the output stage unduly close to the input circuits, with possible feedback problems. As it is, the set is perfectly stable, and any qualms we had about RF coupling within the valve were quite unfounded.

The socket is mounted so that pin No. 1 is, roughly, closest to the 24 mfd electrolytic, and this locates the pins of the triode section conveniently with regard to the IF transformer.

Because of the common cathode connection, the 1 megohm grid leak is no longer returned to chassis but rather to the cathode, and, to ensure that this point is at chassis potential as far as RF is concerned, the 25 mfd electrolytic should also be shunted with a mica or paper condenser of .001 or thereabouts.

The plate load of the triode portion is increased to .25 megohm, while the self-bias resistor for the pentode section is reduced to 400 ohms. Half watt ratings will be satisfactory in both cases. The recommended speaker load is 11,000 ohms, and anything from 10,000 to 15,000 should be quite satisfactory with only a slight reduction in maximum power output if the optimum is not available.

FILTER SYSTEM

The maximum HT voltage of 200 for the plate of the pentode makes it possible to use a simple resistance capacity filter in the power supply, consisting of a 1000 ohm, 3-watt, wire-wound resistor and an 8 mfd 350 electrolytic condenser.

The hum level with this arrangement, but without the decoupling circuit to the plate of the detector valve, is somewhat better than in the original set, though, as we suggested in the article, it may still be high under close listening conditions. If this is so, the set may be rendered virtually hum-free by retaining the decoupling network.

A choke, having the same resistance

(Continued on Page 103)

Serviceman Who Tells

(Continued from Page 71)

turned to more or less normal figbias is incorrect or because it has seen better days. On the assumption that the latter was more likely I plugged the 6V6 into the tester. Result: Approximately 25 pc emission. ures. (I was in too much of a hurry to note the exact values.).

With a new condenser fitted the distortion vanished and the general impression was one of quite good performance. At this stage the owner was getting a little impatient, probably with visions of the wife, kids, and luggage waiting on the front veranda to commence the first stage of their holiday journey.

He was all for taking the set as it was, maintaining that it was quite good enough, but a quick run over the band revealed that the sensitivity at the low frequency end of the band was relatively poor.

Certainly it had no difficulty in receiving 2FC, but there was very little reserve and the performance over greater distances would probably be very poor. Since I knew that at his final destination he would be mainly dependent on the low frequency regionals I was rather keen to improve matters, at least to some extent.

TRACKING ERROR

The fall in sensitivity being at the low frequency end only suggested a tracking error, so I made a few quick adjustments to the padder. The result was an immediate improvement, but only at the expense of calibration, 2FC moving closer and closer to the end of the band as the gain was brought up. By the time a peak had been reached it could only just be tuned in and there was certainly no room for any stations on a lower frequency.

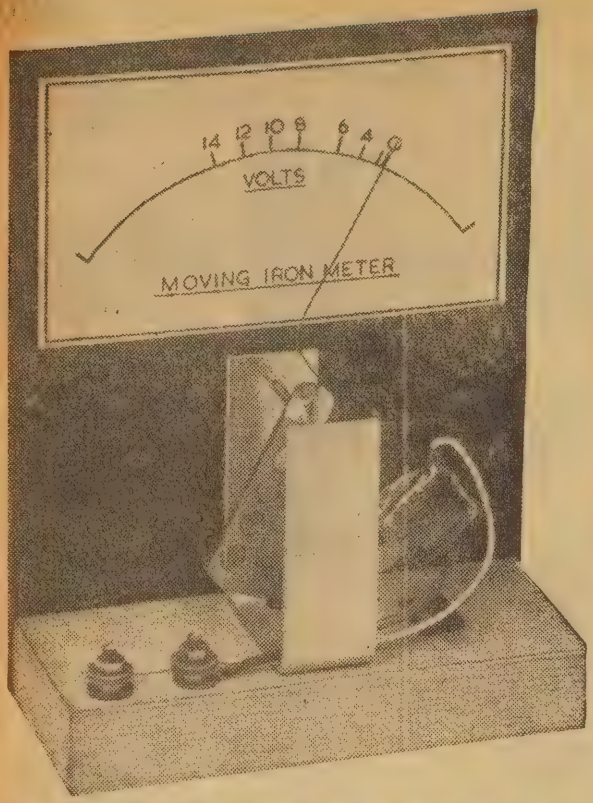
This presented something of a problem. There was no time to investigate the cause of such behavior, though I suspected either a faulty aerial or oscillator coil or maladjusted IF's. On the other hand the stations which had been pushed off the dial were the ones most likely to be required. I decided that the only course was a compromise whereby enough room would be left for these stations but not necessarily retaining correct calibrations.

This was quickly done and together we made a rush installation in the car. Everything functioned correctly when we finally switched on and the owner drove off in high spirits in spite of the brief delay.

POSSIBLE SOLUTION

Since then I have had more time to think about the problem and have come to the conclusion that there are only two reasonable explanations for it. One is that the aerial coil, for some reason at which I can only guess, had shifted its inductance value. The other, and perhaps the more likely, is that the AVC by-pass condenser in the aerial circuit was defective, since a reduction in capacity at this point would seriously upset the tracking of the aerial tuned circuit, practically toward the low frequency end.

One of these days I will have a chance to solve the problem, for the owner has promised to bring the set in again to have the job done properly. However, until he decides he can do without it for a few days, I can only go on surmising.



This moving iron meter was made from scrap parts and calibrated with aid of 1.5V torch cells. The baseboard is 2in x 4½in and the scale is mounted on a piece of masonite 4½in x 5½in. The spindle is made from a nail 1½in long, sharpened at both ends. It is mounted in a U-shaped piece of metal 1¾in x 2in and ¼in wide. The bearings for the spindle are made with the aid of a centre punch. Details of the coil and armature are given on page 79.

If not, obtain a piece of clock spring about 2in long and make a dent in the centre of it with the end of a nail so that it may be balanced on a needle. It is easier to make the piece of clock spring balance if it is left curved rather than straightened.

By the way, clock spring is quite brittle and can be broken over the corner of a piece of iron, or in a vice, and given a gentle tap with a hammer.

MAGNETISING THE POINTER

The next job is to make the spring into a magnet. If you have another powerful magnet rub it along the piece of clock spring in one direction only. The clock spring will then acquire magnetism of its own. If not, you can achieve much the same result by wrapping a piece of thick wire around the clock spring for the whole of its length and then touching the ends of the wire momentarily on the terminals of an accumulator.

The piece of spring will, of course, now behave as a compass needle, pointing north and south when it is again balanced on the end of the needle.

You will need some means by which you can accurately check the movements of the needle when it is installed in the instrument. A good idea is to paint a fine arrow on one end of the spring. Otherwise you could use a grinding wheel to grind one end of the spring to a point. The other end will then need to be ground so that the spring balances properly.

MEASUREMENT OF ELECTRICITY

Just as an engineer needs a rule or micrometer to measure mechanical things so an electrician needs instruments to measure electrical quantities. Nowadays, the making of electrical instruments is a science in itself, given over to highly trained specialists. We can't compete with them but it is very interesting to know something of their work. This article will tell you something about various types of meters as well as show you how to make two useful models.

THE nature of electricity is such that it does not always make itself evident to the five senses in a direct manner. We cannot see electricity in the street light wires, nor can we hear it. If we were to touch the bare wires we would be able to feel the effects of the current, but that could be very dangerous. Further, our judgment would not give us a very accurate idea of the strength of the current.

INDIRECT MEANS

Thus, for various reasons, none of our five senses is satisfactory for providing us directly with information about electricity.

To get over the problem scientists have designed many devices to indicate the presence of electric currents by indirect means.

You will remember that in the December issue we showed how the presence of a current in a wire could be made visible to the eye by its effect on a small compass needle placed near the wire. The stronger the current the greater the movement of the needle.

With a small amount of elaboration an excellent indicating meter can be made with a compass needle and a length of wire wound into the form of a coil.

Such an instrument is called a galvanometer. It is usually provided with a scale, which is calibrated in degrees from 0 degrees to 90 degrees. This is done for a special reason, which we will explain in a moment.

You can make a galvanometer at home from scrap parts in a matter of a few minutes. You will need a compass. If you have a ready-made compass, complete with a graduated scale, it will save you the trouble of making one.

by Maurice Findlay

If you decide on the grinding technique, it is best done before you magnetise the needle, because heat and vibration tend to weaken magnets.

The next job is to make a suitable scale. Given a piece of smooth card, a pair of compasses and some Indian ink, this should not present any difficulties. Mark the scale so that you can read the movements of the needle from 0 degrees to 90 degrees. You can obtain the divisions from the scale of an ordinary protractor.

In its simplest form the galvanometer consists of the compass needle and scale and a piece of wire which runs over the length of the needle. The piece of wire should be fixed so that it runs exactly over the 0 degrees mark and the needle which supports the compass.

When a current is passed through the wire the needle will move. The amount it will move depends on the strength of the current and whether it will move toward the east or west on the direction of the current. Before you can take a reading the whole instrument must be turned around so that the needle is over the zero

position when it is at rest. Both the wire and the needle will then be pointing north and south.

In its simple form the galvanometer is excellent for indicating large currents, but if you proceed much further you will find that a more sensitive indicator is required.

The instrument can be made much more sensitive by winding a coil of fine wire around the pointer. Each turn of wire will then make its own contribution, so that a very feeble current can be detected.

You can buy a reel of 35 gauge or 40 gauge B and S enamel wire from a radio supply store, but, rather than spend the money, ask a radio serviceman for a burnt-out loudspeaker transformer.

SCRAP WIRE

When you take it to pieces you will find a coil of relatively thick wire, and underneath a coil of very fine wire. The coil of fine wire will have one or more breaks in it, but you will find these as you unwind.

Spend a few minutes with some pieces of card and a razor blade to make up a neat former around which to wind the wire. The model aeroplane technique using acetone cement makes a neat job. The former shown in the picture was made in this way.

Wind on as many turns of the fine wire as convenient, mending the break or breaks as you go. Of course, if there are too many breaks, it would be better to try another winding. If you would like to be able to measure heavier currents, wind a few turns of the heavier wire around the outside of the fine wire. Both coils may then be brought out to pairs of terminals.

The next job is to find out how much current is required to deflect the needle. Perhaps the easiest way is to compare it with another meter known to be accurate. The two meters can be wired in series and different amounts of current passed through them. You can make a record of the deflections from which you can construct a calibration chart for the instrument.

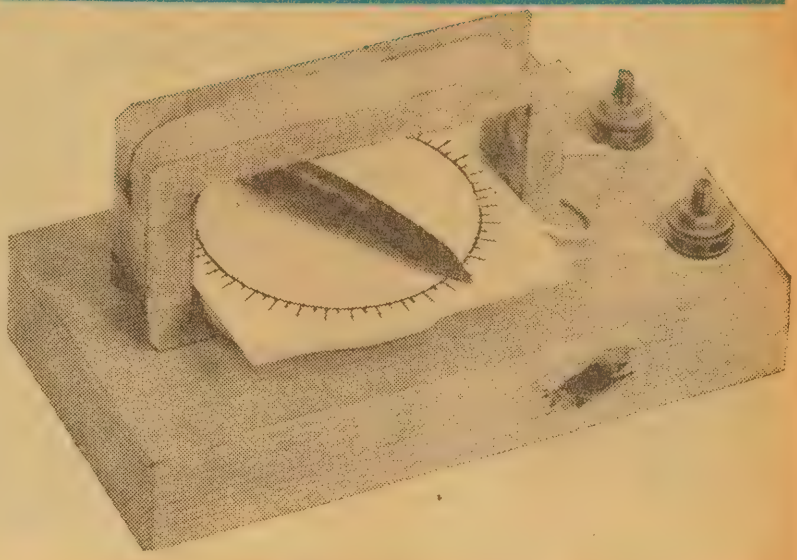
The galvanometer is actually a current-reading device, but since the coil has an unvarying resistance it can be calibrated in terms of volts. By taking an ordinary torch cell as a standard of voltage, calibration points can be found. A commercial torch cell in good condition can be relied upon to deliver 1.5V. Connect one cell across the coil of fine wire and when the needle comes to rest note the deflection.

TANGENT GALVANOMETER

A feature peculiar to this instrument is that the deflection of the needle is proportional to the tangent of the angle of deflection rather than the angle itself. You will find a table of tangents in almost any book of mathematical tables.

If, for example, the original deflection was 5 degrees you will note from the tangent tables that the tangent of 5 degrees of 0.09 (correct to two places of decimals). If you connected two 1.5V cells in series across the coil the needle would be deflected to an angle of 10 degrees. Looking this up in the tables you will note that the tangent of 10 degrees is 0.18. Three cells in series would go to make up 4.5V, which would deflect the needle 15 degrees.

A HOME-MADE GALVANOMETER



A galvanometer can be made from odds and ends in a few minutes. It can be made to give quite accurate readings provided it is carefully calibrated but has to be used in a special position.

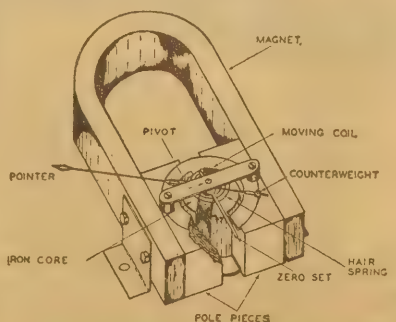
Six volts would deflect the needle 20 degrees, but 7.5 volts would only deflect the needle 24 degrees.

If you were to try 10 cells in series, making 15 volts, you would find that the deflection would be only 42 degrees, instead of the 50 degrees that would be expected from a linear scale.

A check with the tangent tables shows that the tangent of 15 degrees is 0.27, 20 degrees 0.36, 24 degrees 0.45 and 42 degrees 0.90, proving that the deflection is proportional to the tangent of the angle. Actually, almost 20 volts would be required to deflect the needle 50 degrees.

Very high voltages are required to make the angle of deflection approach 90 degrees and there is a danger of damaging the batteries or burning out the coil. If you wish to read higher voltages it will be necessary to add resistance in series with the coil.

A similar procedure may be used to calibrate the instrument with the coil of heavier wire except that this coil will be most useful for measuring currents. Unfortunately, it may be difficult for you to obtain a standard from which to take a calibration point.



This cut-away drawing of a moving coil meter shows the essential parts. Many commercial meters are of this type but because of the need for special tools it is impractical to make a model at home.

The galvanometer is a very interesting instrument with which to make experiments. It is frequently used in the laboratory, especially in connection with a device called a wheatstone bridge, where its feature of giving smaller and smaller increases in deflection for linear increases in current is very useful. If you take care with the marking of the scale and checking of the calibration points the instrument can be made quite accurate.

However, it has the obvious disadvantage that it must be used horizontally and also it must be turned so that the coil is in line with the earth's magnetic field.

MAGNETIC FIELD

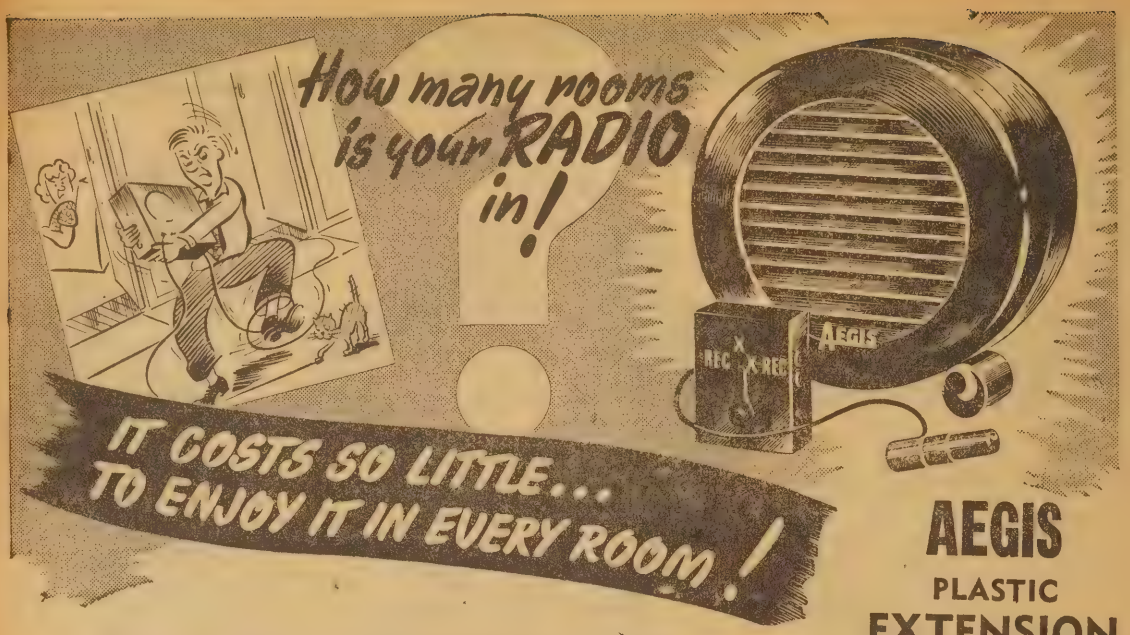
This disadvantage is overcome in other types of meters by making use of the field of a powerful magnet, rather than the relatively weak field of the earth. A further development is a meter which, instead of having the coil fixed and the small magnet able to move, has a small coil which is able to rotate in the field of the powerful magnet.

The principle of the meter is the same as that of the simple galvanometer in that the action depends on the forces between a fixed magnet and an electromagnet. However, as permanent magnet is heavy and bulky, it is better to have it fixed and allow the coil to move.

It is relatively easy, where the proper tools are available, to make a light coil which can be attached to a pointer. This type, therefore, is known as a moving coil meter.

It is probably the most popular nowadays for radio and electrical work, having a number of advantages over other types.

Provided the pointer and coil is properly balanced it may be used in any position without affecting the calibration. If the magnet and pole pieces are properly designed the scale is linear. The direction of reading



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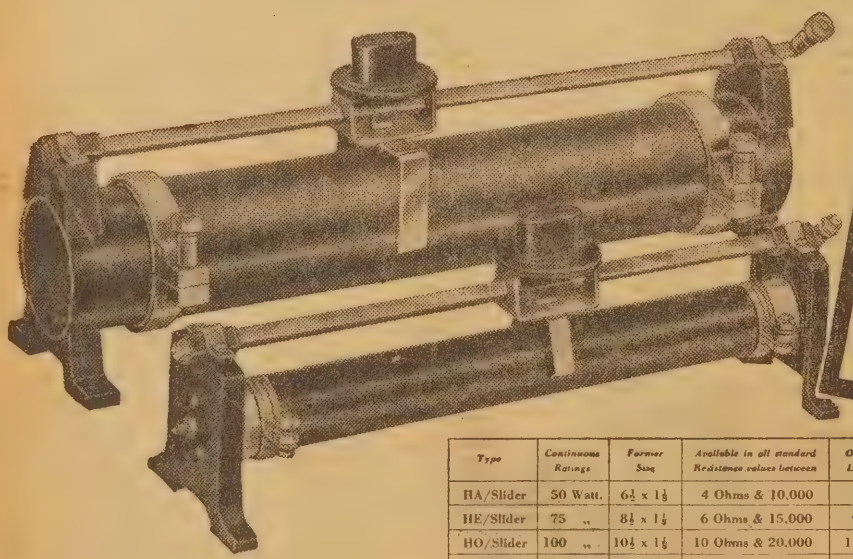

These resistances are very suitable for laboratory, experimental and educational applications. Contact wear and resistance are reduced to the absolute minimum and, in this respect, all types are fitted with multiple fingered, phosphor bronze contacts that bear on both sides of the wound tube.

Type	Continuous Ratings	Former Size	Available in all standard Resistance values between	Overall Length	Overall Height
HA/Slider	50 Watt.	6½ x 1⅛	4 Ohms & 10,000	7⅞"	3¼"
HE/Slider	75 "	8½ x 1⅛	6 Ohms & 15,000	9⅞"	3¾"
HO/Slider	100 "	10½ x 1⅛	10 Ohms & 20,000	11¼"	3¾"
XAS/Slider	200 "	12⅞ x 2⅛	2 Ohms & 10,000	13¾"	4¼"

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The field around a permanent magnet is illustrated in this diagram with the aid of some iron filings. This particular magnet is especially designed for a moving coil meter. Note that the lines of force are evenly distributed in the area between the pole pieces. If this were not the case the scale of the meter would not be linear.

depends on the direction of the current so that it is possible to determine the polarity of the circuit being tested.

The coil of the meter is usually wound on an aluminium former. This has a very important advantage. As the coil moves in the magnetic field the aluminium former, which moves with it, has a current generated in it. This current in turn generates another magnetic field which tries to oppose the action of the needle.

This secondary action can never be strong enough to stop the pointer from moving. In practice the pointer merely moves more slowly and comes gently to rest at the appropriate reading. This is in contrast with the tendency of many other meters to oscillate backwards and forwards over the reading for some time before coming to rest.

MOVING COIL METER

We have included a diagram showing the essential parts of a moving coil meter, but with the scale removed. You will find many opportunities to have a good look at moving coil meters in various pieces of electrical apparatus. The arrangements for bringing the pointer to rest at zero and conducting the current to the coil are quite ingenious.

Unfortunately, a great deal of mechanical skill is required to make a successful moving coil meter, so that we will not attempt to describe the construction in detail.

On the other hand the moving iron type of meter is one which can be made at home without too much difficulty. Before moving coil meters came to be generally used, moving iron meters were used extensively commercially. They are not as inherently accurate as moving coil meters, but are somewhat less expensive to make.

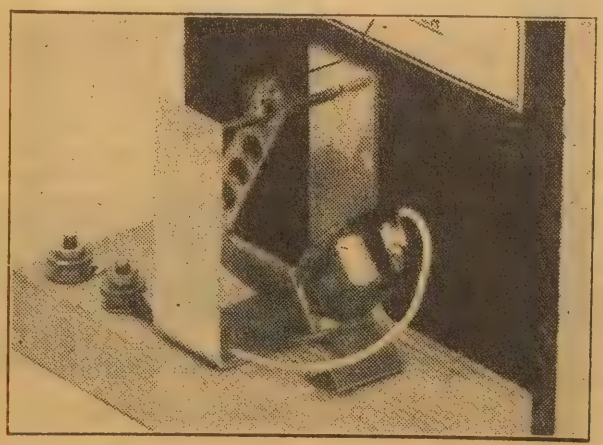
There are several standard types of moving iron meters, but the type which is perhaps the easiest to understand consists essentially of a coil of wire, which is fixed to the frame of the meter and a soft iron armature which is free to move. The pointer is attached to the armature.

When a current is passed through the coil it becomes an electromagnet which, in turn, magnetises the armature by induction, so that the armature and coil are attracted to one another.

The armature is usually controlled by a spring in commercial models. However, in the model shown in the photographs, the armature is controlled by action of gravity.

If you have access to another meter from which the model can be calibrated well and good. Otherwise, the calibration points can be taken from a set of torch cells.

Both the galvanometer and the moving iron meter will be found very useful in electrical experiments you will wish to undertake later so that it is well worth while to make them neatly and take care with the calibration.



Close-up of the bobbin and armature of the home-made moving iron meter. The bobbin consists of a large number of turns of fine wire wound on a former 3/16in x ¾in x 5¼in long. The armature is of the shape of a scythe the "handle" being 1¾in long and the "blade" 2in long and of radius 1½in. It tapers from ¼in at the root to a point at the end.

The WARBURTON FRANKI Page

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⅛", 5/32", ⅜"

Washers—Brass

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7/16" x 5/32 Hole
⅝" x ¼" Hole

Spacers—Brass

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½" Long 5/32" Hole
¾" Long 5/32 Hole
1" Long 5/32" Hole

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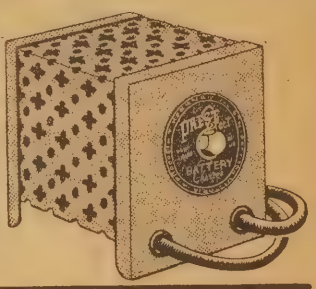

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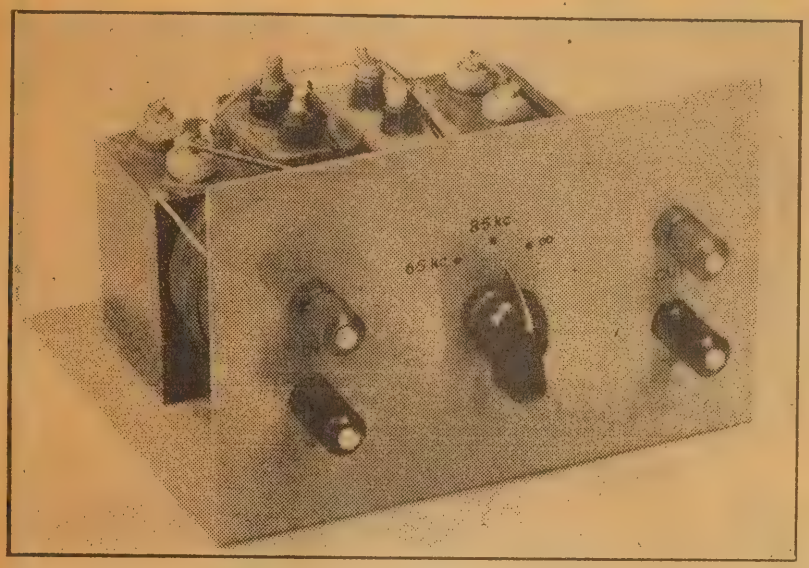

This view of the unit gives an idea of one method of construction. The switch can be fitted with an extension shaft of any length, if necessary, to allow the unit to be placed in a more convenient position.

Here is a simplified version of our voice-coil top-cut filter, which allows the frequency response of wide-range speakers to be controlled readily. It provides the complete answer to the unpleasant results which are encountered when feeding such a speaker with signals containing a high degree of inherent distortion.

ALTHOUGH we have stressed this matter on previous occasions, it is obvious that plenty of readers still do not understand why the reproduction from wide-range speakers is often disappointing — even to the extent on occasions of being downright objectionable.

The distortion, which may be absent from some programs and painfully apparent on others, generally imparts a rough "buzzing" quality to all high notes. The effect is not unlike that produced by a loose turn on the voice coil or some similar mechanical defect. Occasionally, peaks in the response curve are blamed.

In actual fact, wide-range speakers, like all other types, do exhibit peaks and troughs in their response curve. While these are undesirable, they do not alone account for unsatisfactory reproduction. On the contrary, under favorable conditions, wide-range speakers are generally capable of excellent reproduction.

SIGNAL DEFECTS

The simple explanation, rather, is that wide-range speakers and equipment show up to a painful degree the very serious distortion which is present in the upper register of many radio programs and most 78 rpm records. The distortion is not so apparent on ordinary speakers, because their efficiency above about 6½ Kc falls off rapidly.

A filtering action takes place by which the extreme treble and the high-frequency distortion components are lopped off and all programs tend to be reduced to a mediocre sameness. The more drastic the limitations of amplifier and speaker, the more alike will be the quality of all programs.

With wide-range equipment the "filtering" action is not apparent and every program played is heard in its naked reality—high fidelity or high distortion! Herein lies the problem.

The only really effective answer is to provide a filter which can be switched into circuit when required and which will cut off the response sharply at selected frequencies.

☆

The capacitors used in this unit were from disposals sources. The chokes are mounted with simple angle brackets. Note the space around the edges for the fitting of a dust cover. All holes in the base plate are counter-sunk.

A slow roll-off is seldom adequate because by the time enough top-cut is provided to eliminate the upper treble response severe and needless attenuation is also evident in the 3 to 6 Kc region.

By and large, our experience is that some kind of sharp-cut filter is essential with any wide-range and/or twin-cone speaker. To judge by magazine references, overseas experience is much the same.

POSITION OF FILTER

Sharp-cut filters may be installed in association with a special stage, usually included early in the amplifier chain. While technically very effective, such a stage requires an extra valve and tends to add to the usual problems of hum, microphony, motor-boating, &c.

It has proved quite practicable, however, to design a filter for inclusion in voice-coil circuits of the 15-ohm variety, common to most wide-range speakers. The 2-ohm voice coils in some local speakers present a special problem and may be covered at a later date.

The original R&H voice-coil filter (Jan., 1950) was a comprehensive affair, providing cuts at 4½, 6½, 8½ and 11 Kc with a "wide-open" position for unrestricted listening. The figures are nominal only, in that they will vary either way with variations in rating of home-wound chokes and oddment condensers.

Continuous use of the unit has since demonstrated that three positions will meet most requirements:

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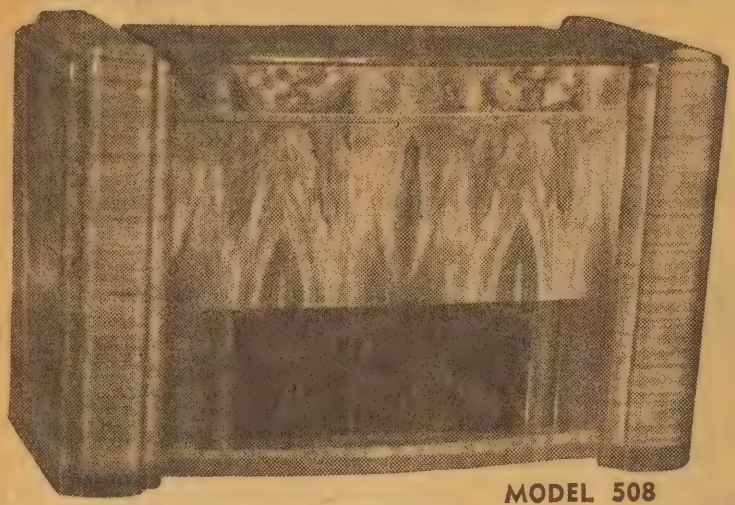

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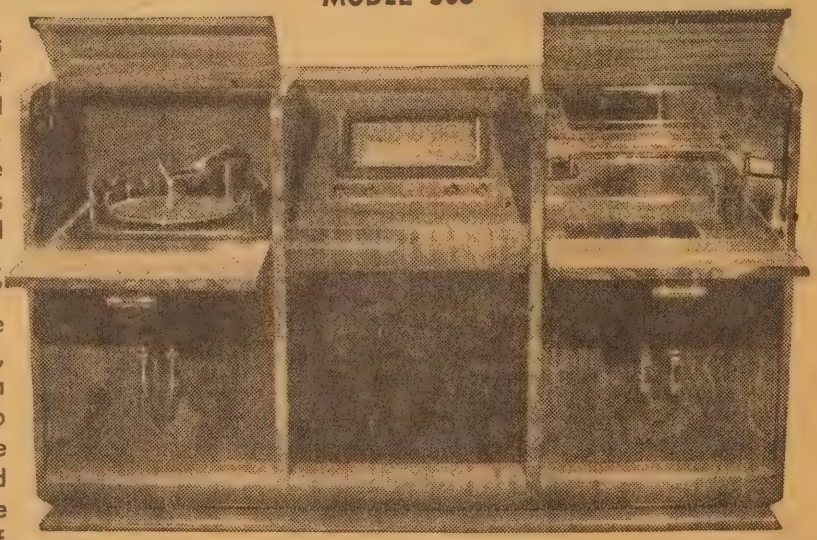
MODEL 508

Model 508 is suitable for all types of record changers.

MODEL 511 is a high grade cocktail and radiogram cabinet suitable for all types of record changers. Made of 1" solid core Italian walnut, finished in a brilliant piano finish. Ample bottle and record space each side of speaker grille.



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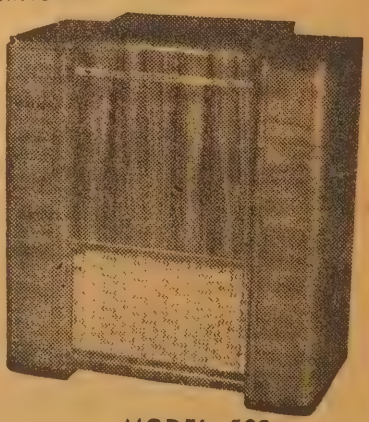

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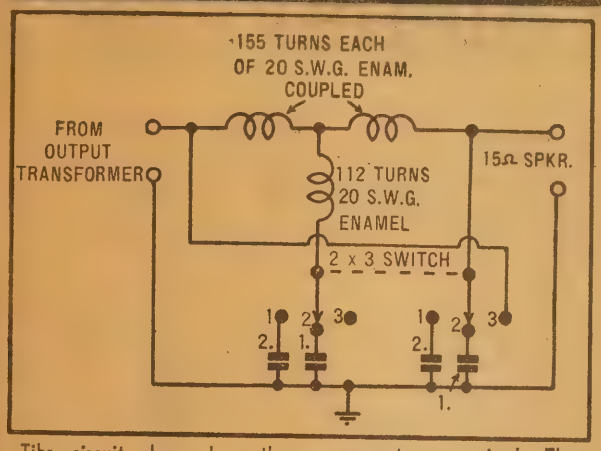
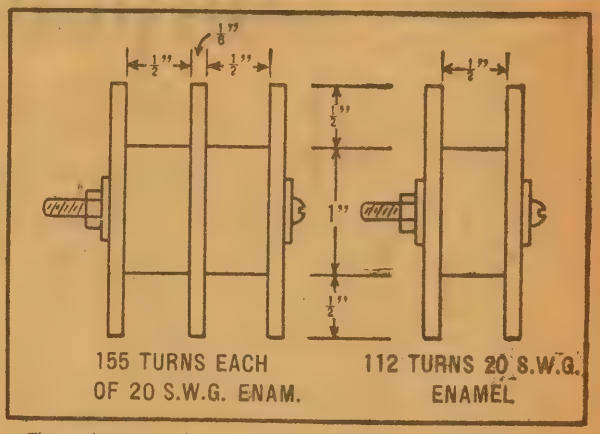


Tihs circuit shows how the components are wired. The components' values are reasonably critical if the exact cut-off characteristics are to be maintained. The nominal cut-off frequencies are 6.5 kc for position 1 and 8.5 kc for position 2.



These dimension details should enable you to duplicate with reasonable accuracy the chokes used in the original unit. The original formers were made from scraps of broom handle and Masonite, but any similar materials may be used.

(1) "Wide-open" for good programs and good microgroove discs.

(2) An 8.5 Kc cut for all general listening. This position also cuts the 10 Kc whistle on stations, where a whistle filter has not already been installed in the tuner.

(3) 6.5 Kc, or thereabouts, for doubtful 78 rpm records. This corresponds with broadcast station practice. Records requiring more severe cut are scarcely worth consideration.

By accepting these figures it becomes possible to delete the troublesome 4 mfd condensers and achieve the much more compact layout illustrated here.

The circuitry of the filter unit is still basically the same as that published in the January, 1950, issue of Radio and Hobbies, the only modification being in the number of switch positions. A single section, 3-pole, 3-position wafer switch allows for cut-off at about 6.5 kc and 8.5 kc and for "straight-through" operation in the third position. Only two poles of the switch are required.

HOW IT WORKS

The trap circuit is resonated to the appropriate frequency for each position by the capacitors selected by the left-hand switch section. However, this circuit on its own produces a relatively slow roll-off on the high frequency side, and, to sharpen the knee of the curve, the capacitors across the output produce a secondary series-resonant effect. It also prevents the output rising again in the upper register.

The capacitor values are reasonably critical and some effort should be made to get them near the mark. It is wise to avoid capacitors which show signs of leakage (either physically or electrically!) as these most likely will have departed widely from their marked value. We could place in this category any of the "old-timers" from the pre-electrolytic era.

Capacitors of more recent manufacture, including those salvaged from disposals equipment, will, in general, turn out to be satisfactory as far as condition and capacitance value is concerned.

Remember that a series or parallel connection of, say, two capacitors can be employed to obtain the required value. For the 1 mfd values in this unit, we used two blocks, each marked "2 x 0.5 mfd." On the capacitance bridge, each section measured 0.55 mfd. The two terminals or lugs were joined and used as one connection, with the can itself as the other.

MAKING THE CHOKES

The construction of the chokes will constitute the greater portion of the work on the unit. To assist you here, we have included a diagram showing all measurements. Incidentally, the average broom handle has a diameter of 1-inch and the couple of inches required for the centre spacer of each bobbin will not normally be missed.

The end cheeks can be made out of masonite, bakelite or 3-ply. A circle-cutter is very handy for this job, a cut being made from each side to avoid splintering or chipping. After the five cheeks have been rough-cut, clamp them together with a bolt through the centre, grab the free end of the bolt in the chuck of an electric drill or wheel brace and turn them smooth with a file, rasp or glass paper.

In assembling the bobbins, we used a 3-16th in. dia. brass bolt for each, with a washer under the head and under the nut. A steel bolt of this, or larger, diameter, may alter the inductance value unduly.

The wire should be laid on to the bobbins, following the layer-wound technique as closely as possible to ensure that the mean diameter of the finished choke will not deviate unnecessarily from that of the original. Incidentally, if you cannot obtain 20 S.W.G. enamelled wire, 19 B & S is a satisfactory alternative.

A simple method is to turn the bobbin with a wheel brace mounted in a vise, feeding the wire on under tension from a spool. First find the exact gear ratio of the brace by counting the teeth, secure it in the vise and clamp the free end of the bobbin bolt in the chuck.

Clamp a rod or screwdriver to a bench behind or in front of you to act as an axle for the spool from which the wire is to be taken. Feed the end of the wire through a cheek to give several inches of free end and give it a kink near the hole to prevent it pulling through under tension of winding.

After about half of the winding is complete you will probably find that the layers are tending to lump, due to the turn-over at each end. You can do little else at this stage than attempt to fill the gaps in the surface so that the finished winding is fairly level and not heaped up at the centre.

As each choke is finished, run some insulation tape around the winding to hold the turns permanently in place.

In the case of the two coupled windings of 155 turns each, bring out the ends to each separately, rather than take the end of one winding down the inside of the middle cheek to start the other. This latter method can sometimes lead to the exasperating business of shorted layers in the winding.

MOUNTING PILLAR

When wiring the unit, use a threaded insulated mounting pillar to carry the junction of one end of the 112-turn winding, the outside end of one of the 155-turn windings and the inside end of the other 155-turn winding. This arrangement connects the coupled windings in the correct phase.

The layout of your filter will depend largely upon where you desire to mount the range knob. For instance, you may want to mount the unit under the motor board or on the speaker baffle, so that the knob can be brought into the pattern of the existing controls with or without the use of an extension shaft.

Fortunately, the only important point to watch in the layout is that the chokes are separaed by at least their daimeter, are at right angles to each other and are not crowded against a metal corner or front panel.

Because the unit operates at low impedance, lead length is not important, up to a point. This suggests that the switch could be mounted separately and the connections taken to it through a made-up cable. Some discretion is necessary though, to avoid upsetting the design values of the components.

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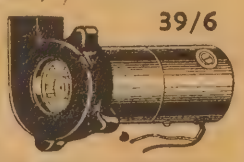

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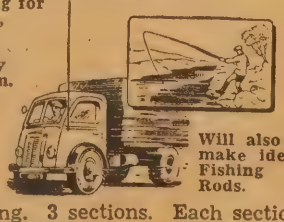

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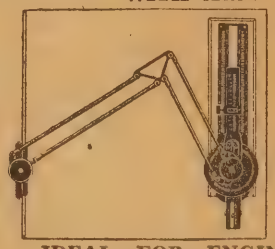

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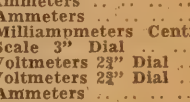

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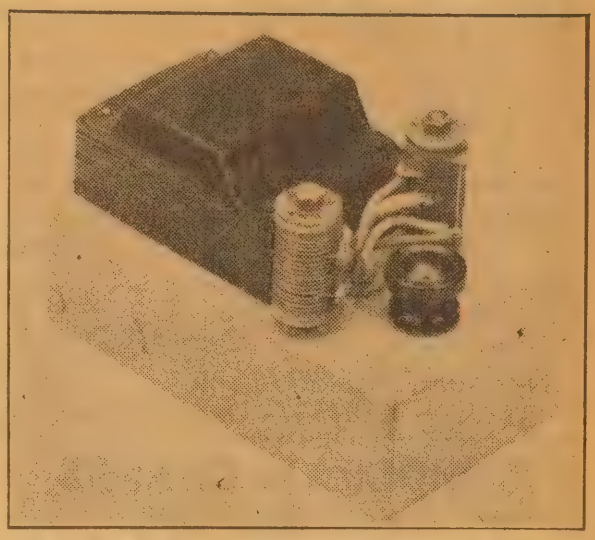
TRICKLE-CHARGER FROM ODDMENTS

This little charger will keep your blackout battery topped-up without any attention. It draws very little current from the power mains and can be built up with the kind of components most likely to be available to a hobbyist.

THE writer has been usng, for some months, a blackout lighting system along the lines described by Phil Watson in the March, 1952, issue. It has proved of special value recently and takes the sting out of evening blackouts, especially as regards light in the kitchen for the evening meal.

One point about the scheme which does not appeal to a lazy man is the necessary battery charging arrangements. Up to date, the battery has been kept up to the mark with a home-made 5-amp charger, which formally resided in the family garage.



The original charger, built up on a small metal chassis measuring 6 x 3 x 1¾ inches. The transformer was an old-style filament transformer with a new hand-wound secondary. Requisite voltages for 6 and 12-volt circuits are given on the circuit diagram.

☆

STATE OF BATTERY

With this charger it is necessary to keep some track of the blackout periods and do minor mathematical sums to make sure (1) that the battery is always full when required, and (2) that we don't waste power and electrolyte by unnecessary charging.

To avoid even this uncertainty, the idea was born of installing a "trickle" charger which would keep the battery in good condition without danger of over-charging. It would simply be left on all the time and the charging rate set to cover normal battery losses plus the lighting requirements for so many hours a week.

A further and most important advantage of such a system is that, in summer months, a continuous small trickle charge will prevent any tendency to sulphation and maintain the battery in perfect condition for later use. Batteries which suffer long periods of idleness, with only spasmodic charges, deteriorate quite rapidly.

OLD SCHEME

The idea of "floating" a trickle charger across a bank of accumulators is, of course, not new, being commonly employed in telephone exchanges, broadcast stations and such like.

We started asking a few questions about the scheme in order to discover how much a typical battery loses by pure internal losses or "self-discharge." To this would be added the estimated blackout load requirements, allowing a figure to be obtained for the permanent charging rate in amps.

One can obtain all sorts of "learned" discussions about self-discharge from text books and experts generally, but the most useful figure was supplied by a Sydney battery manufacturer, who suggested that an ordinary car battery, in good condition, is likely to show a self-discharge of 25 pc of its rated capacity per month.

This means, in effect, that a full 100-amp-hour battery will lose the equivalent of 25 amp hours in a month by self-discharge, so that a charge equivalent to 25 amp-hours must be put back merely to keep the battery full.

We discovered, further, that a battery "floating" on trickle charge should maintain a nominal potential of about 2.13 volts per cell, or 6.4 volts for a 3-cell car battery.

Both the rate of self-discharge and the floating voltage will vary somewhat with the condition of the battery, strength of the electrolyte, prevailing temperature and so on, but the figures quoted can be taken as a good general guide.

Taking a figure, therefore, of 25 amp-hours self-discharge and 700 hours of charging time per month, the rate of charge necessary to maintain the battery works out at .035 amp., or 35 milliamps.

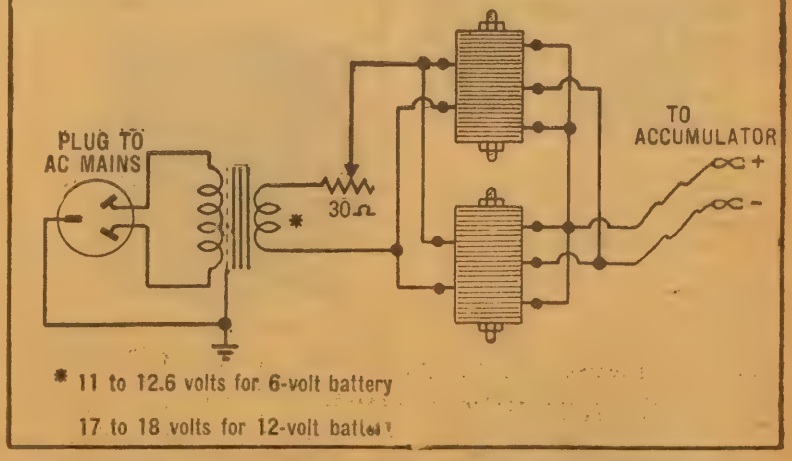
If we assume that the average blackout battery is a half-worn car accumulator, showing somewhat higher losses, it may be necessary to double the figure, but at least we've gotten somewhere! To maintain a blackout battery, you can expect a trickle charging requirement of about 35-70 milliamps.

As far as load current is concerned, the minimum requirement would appear to be about three hours per week, using a single 25-watt globe. In a calendar month, this works out at about 52 amp-hours from a 6-volt system, requiring a charging rate of 75 odd milliamps. The current load in a 12-volt circuit would, of course, be lighter.

If you want to use a single 40-watt globe instead of the 25-watt, or if the blackouts are longer, or if a second 25-watt globe is used occasionally in another room, a proportional increase will need to be made in the charging rate.

By and large, however, it means that the necessary trickle charge rate will vary from about 130 milliamps

(Continued on Page 87)



The circuit is simplicity itself. Two rectifiers will handle easily up to 200 mA. A third rectifier could be used, or any larger bridge type, if higher charging rates are required.

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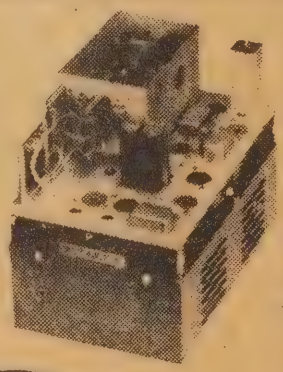

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"PLAYMASTER" AMPLIFIER No. 5

(Continued from Page 33)

hum to be introduced unless the filament circuit is centre-tapped. This is a small improvement, which could apply to all the Playmasters.

The positively biased filament is another precaution against hum through heater emission in the higher gain stages of the equipment.

The 2A3 is a valve with a very high transconductance, and it's a good plan, therefore, to get a pair which have been balanced on a mutual conductance tester if you can.

It's only fair to say, however, that we checked a number of valves this way before selecting a pair for this amplifier, and we found very little variation between them. So once again, don't be broken-hearted if you aren't able to get a perfectly balanced pair. If it comes to that, the makers recommend balancing the valves in all big amplifiers, but we think this might be rather superfluous for our purposes.

The first valve in the amplifier is a 6AU6 which is the standard pentode for use in this application. You will notice, however, that a rather low value of plate resistor is used, to limit the voltage gain from the stage. The overall gain of this amplifier is quite large, despite the 2A3's, and we found it necessary to use a very high degree of feedback —about 26 db—to reduce input sensitivity to 350 mv.

LOWER FEEDBACK

This very high figure tended to allow slight motorboating at high volume levels, and it was considered wise to reduce the total gain to drop feedback to about 20 db. The amplifier should be quite stable except possibly at full output and full extra bass boost from No. 2 control unity. This isn't at all important, as it would be virtually impossible to run the amplifier this way. Full boost is useful only for moderate to low volume. You could try using the more normal .1 plate and .25 screen resistors to get the extra feedback, but there isn't much point in doing so.

Feedback once again is taken from the voice coil winding to the cathode circuit of the 6AU6. Make sure you have the connection to the right side of the winding, although you can only find this out by trial. The wrong connection will set up violent oscillation as soon as the valves have warmed up. Switch off immediately and reverse them if this should happen.

The amplifier will consume about 95 mills at 400 volts or thereabouts. In order to allow for the current drawn from the tuner, if used, the power transformer and choke should have a current rating of 120 mills. The choke will probably carry a rating of 20 henries inductance or thereabouts.

The main filter condensers should be of the 600-volt type, although because the output valves will heat up at about the same rate as the rectifier, the voltage will not normally rise over 400 volts.

The decoupling circuit used in the phase-changer plate supply could probably be left out without endangering either stability or increasing hum level. We included it more as a precaution, using a low value of decoupling resistor to avoid too great a reduction of the effective plate voltage.

The performance of the amplifier is particularly good. It has an exceptionally low hum level, as low if not lower than the previous Playmasters.

Its frequency response is extremely flat, being within about 1½ db from 20 cps. to 50 kc at approximately 2 watts output. Its output on the primary side is between 10 and 11 watts. Output available for the loudspeaker will depend on the efficiency of the output transformer, but should not be less than 8 watts. Some of the better quality transformers will run to 90 pc efficiency or even higher, giving almost 10 watts output. In any case, this is plenty for almost any enthusiast, and far more than will normally be used with a high-grade speaker.

TRICKLE CHARGER FROM ODDMENTS

(Continued from Page 85)

for an economical system to double the figure where the losses or load are likely to be high. Neither figure is alarming.

Having determined the requirement, we went ahead and built up the little charger shown in the photograph. Most interesting feature is the use of two miniature rectifiers of the type which is used in telephone relay strips—and sold by the thousand through disposals sources for a couple of shillings each.

These have been credited with all manner of current ratings, from 50 to 100 milliamps, the manufacturer's figure being apparently 80 milliamps in well ventilated situations. Actually, we let them run for hours on test at 100 milliamps and, when bolted to an ordinary chassis in open air, they never became more than perceptibly warm to the touch.

Two in parallel would therefore be quite adequate for charging rates up to 200 milliamps. If you wish to go higher than this, it would be possible to use three or more without difficulty.

BRIDGE RECTIFIERS

These rectifiers are bridge types and operate with the same input voltages as the larger LT53 rectifier specified in the standard Radio and Hobbies battery chargers. How you get the necessary volts is a matter for individual arrangement.

It would be possible, of course, to use the standard R&H battery charging transformer, but this is much larger than necessary. There is every chance that manufacturers will put onto the market a small transformer with lower current rating and, of course, at a lower price.

In the meantime, use might be made of an oddment power or filament transformer, either by connecting the existing filament windings in series or by winding on a new secondary.

For the 6-volt charger, anything between 11 and 12.6 volts is satisfactory, the nominal optimum figure being 11.7.

For a 12-volt charger, something like 17 volts is required as, for example, from two 6.3 and one 5.0 volt winding all connected in series.

When connecting windings in series they must be properly phased so that the voltages add rather than cancel.

To control the charging rate resistance is connected in series with one a-c lead to the rectifier. Its exact value will depend on the input voltage, the condition of the rectifier and battery, the line voltage and so on, but you can expect anything from 5 to 15 ohms for a charging rate of 200 milliamps.

The simplest approach is to obtain a variable resistor of about 30 ohms. It may be one with a sliding clip, a modern potentiometer, or one of the old filament rheostats from a discarded battery set

The charging rate is likely to vary somewhat as the rectifiers warm up and the multimeter is best used to keep the rate to about 200 milliamps over the first quarter-hour of operation.

Run the charger at this setting for a couple of weeks and note whether the battery meets all load requirements. If so, you may be able to reduce the charging rate progressively until it reaches a minimum figure consistent with your blackout requirements. It's not a critical adjustment as much as avoiding unnecessary use of power.

One final point you might be worried about. The actual output of the charger is only between 2 and 3 watts, which would hardly be sufficient, of itself, to turn the power consumption meter. The transformer you use will add slightly to this figure by way of magnetisation losses.

With a good transformer these will be negligible, but a poor transformer will consume enough power to get quite warm, or even hot. If you are worried on this score you can check the loading on the power circuit by switching everything off but the charger and counting the rpm of the power meter disc.

Compare the rate with, say a 15-watt globe in circuit and do a little calculation. We don't think you'll be alarmed.

SIMPLE TWO-NOTE DOOR CHIMES

Readers who have baulked at the construction of the more complicated types of door chime will be interested in this simple two-note chime, which is built for the most part around an ordinary electric bell. The only other items worthy of note are the two lengths of one-inch diameter metal tubing.

By P. F. HAMM

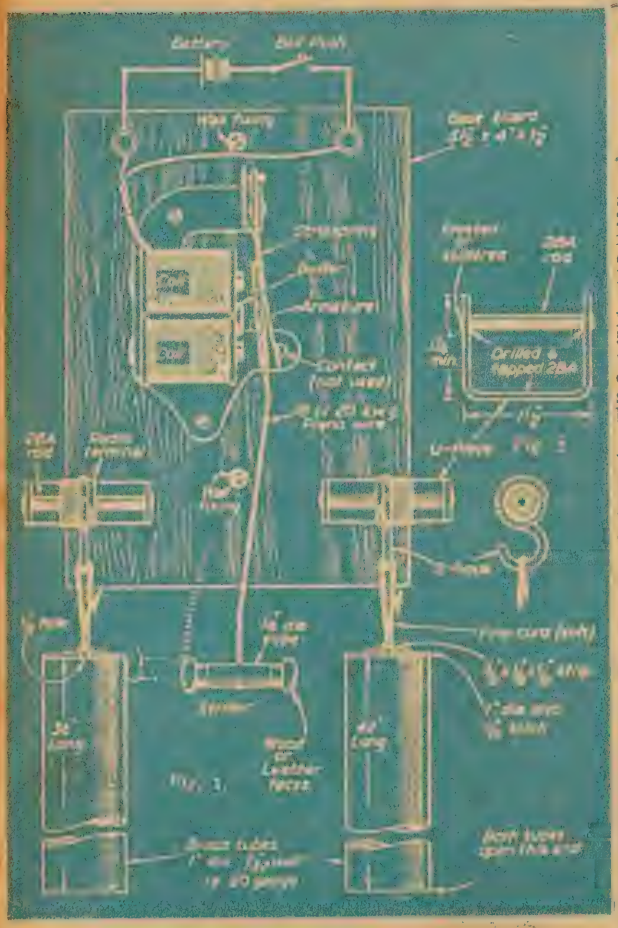


Figure 1 (left) a general view of the chime mechanism and figure 2 (right) details of the chime support devices. Grooved head-nuts from metal terminals screw along two threaded rods and allow the precise spacing of the chimes to be adjusted. An ornamental cover can be placed over the bell assembly

THE striking unit of these chimes is so arranged that, when the door press is operated, the armature is drawn over and stops, making the clapper and wire whip far enough to hit chime one.

On release the armature spring reacts and chime two sounds. As both oscillations are damped, careful adjustment of the chimes prevents a second strike.

The results compare well with the more conventional solenoid.

Many readers will no doubt find most of the few required materials handy, probably left over from the previous job, except perhaps for the tubes.

MATERIALS REQUIRED

The materials required consist of about 14in 18-20 swg piano wire; 1in of ¼in, OD copper tube, thick walled; 9in of ½in by 1-8in MS strip; 2 electrical terminals of the type with an annular groove; 2 more complete for base fixing; 3in of 2 BA rod; 5in of 12 swg wire.

Also a piece of hardwood for base, 5½in by 4in, by ¼in; wood or leather for clapper faces; and a small piece of rubber for a buffer.

Any type of bell will do, though it is doubtful if the small buzzer types would produce enough power.

The bell and its immediate mounting are removed. So is the fixed contact and its mounting, as they are not required; nor is the moving contact.

The clapper and wire are removed from the armature and the piano wire soldered in their place. The ¼in diameter tube is drilled transversely with a No. 56 drill, and sweated to the other end of the piano wire.

If thick-walled copper tubing is not available, the substitute should be loaded inside with solder. The unit can now be screwed to the base board leaving the two coil ends visible. (Fig. 1.)

The strip metal for the chime supports is cut in two and each bent to form a square U shape, as shown in Fig. 2. They are drilled No. 24 and tapped 2 BA. Run the terminals on the rods and rivet or solder the ends.

The 12 swg wire is formed into two S-hooks, one of which is fitted into the groove of each terminal, just free enough to allow easy rotation of the terminal. The supports are now fitted to the base with c/s machine screws from the rear, in the positions shown.

For the chimes, 3ft and 3ft 6in lengths of 1in OD 20 swg brass tube will be found to give a pleasing tone. One end of each is closed with a brass disc and an eyelet formed to take the cord loop. The disc has a 1-8in diameter hole in its centre. The other ends are filed clean and left open.

Two buffers, shaped from wood or leather, are fitted to the striker tube. They affect the tone to a considerable degree. Wood produces a loud, and leather a softer but mellower, tone. The base is now hooked to the wall to enable the length of cord to be decided upon.

With the S-hooks in a mid-position, vary the length until the buffer strikes at the top edge of the chime at its nearest point, ie, with the striker in a line with both chime centres. The cord is then knotted and the chimes removed.

Back on the bench the details can be attended to. The two coil ends are taken to terminals at the top of the base board either direct or through convenient holes and channels under the base. The polarity is not important.

SETTING UP

On the wall again final adjustments can be made. With the coils energised the striker should not quite touch the left-hand chime, adjustment being made by rotating the terminal. The exact position will be obvious from the sound. A similar adjustment will position the other chime.

The base must be secure on the wall or the adjustments will be thrown out. The rubber buffer shown between the coils reduces the noise of the armature and should protrude just beyond the pole faces. Leather or resilent plastic could be used.

The dimensions quoted for the base board are for use with external power. Mains transformers, 6v. and 2v. accumulators have been tried and found satisfactory, though these will depend somewhat on the coil size.

If a dry cell is to be used it could more conveniently be built in. The twin-cell cycle battery is recommended.

The design of the casing is left to the reader. By elongating the clapper hole in the original bell cover this could be used, or a more distinc-

(Continued on Page 101)

"Record" Values at *Maxwell's*

Brilliantly designed to "take all records."

The New COLLARO

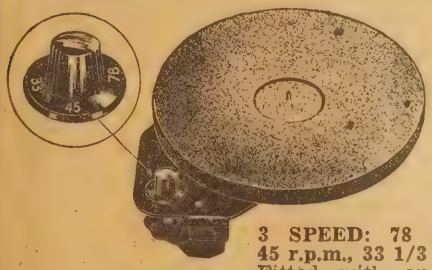
3-speed Automatic Record Changer Model 3RC511

Pre-set speed regulator and record size to play 9 x 7" or 9 x 10" or 9 x 12" discs.

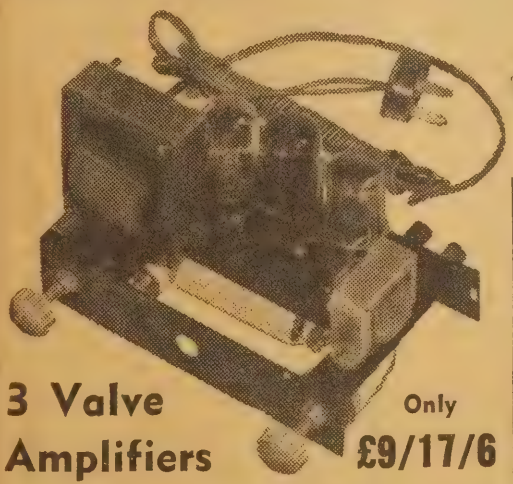
Keenly priced at **£22/10/-** **Includes Two Heads.**

Electric Grammo Motors

ENGLISH BSR Motors £7/18/6



3 SPEED: 78 r.p.m., 45 r.p.m., 33 1/3 r.p.m. Fitted with an easy change-over switch. Very reliable English motor. Complete with turntable. Leatherette Cabinets to match, 85/-.



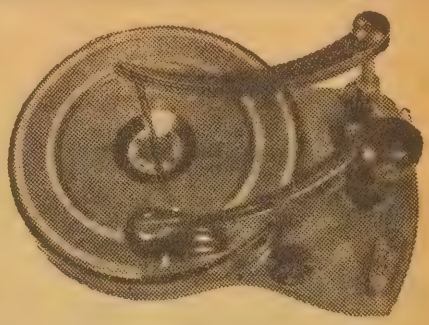
3 Valve Amplifiers

Only £9/17/6

As illustrated. Incorporating Valves, 6 x 5, 6V6GT, 6SJ7—Inbuilt on/off Switch, Volume and Tone Control, etc. Size: 7" x 4½" x 5½" high.

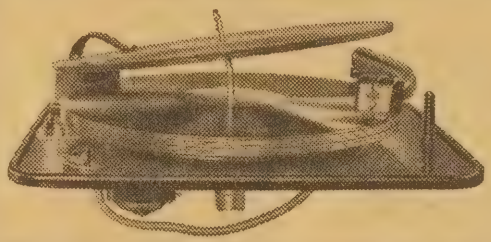
ALL FREIGHT FREE!

The New "PLESSY" Automatic Multi-Speed Record Changer



Specifications: 78 r.p.m., 33 1/3 and 45 r.p.m. Automatic changer on the three speeds. Mixes 8" and 10" Records. Microcell Pick-up with dual pointed Stylus. Easy switch over operation for various speeds. Smart appearance and non-warping turntable. Supplied with a complete Booklet, giving clear installation instructions.

Yours for 25 gns.



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£13/15/-

This unit will play 10" and 12" records. Great value at this special price!

G.U.4 MOTORS

3 Speed unit 78, 45, 33 r.p.m.

With Crystal Turnover Head for Speed Variations.

● **Immediate Delivery.** **Buy NOW 15 Gns.**

With an automatic stop. Lightweight high fidelity crystal turnover head pick-up.

● Easy change-over for various r.p.m. ● Suspension Spring mounting. ● Pressed steel turntable. ● Ultra modern in appearance. **Leatherette Cases to Suit, 85/-.**

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48 ELIZABETH STREET, MELBOURNE. CENT. 4913

SHORT WAVE NOTES BY RAY SIMPSON

"VOICE OF AMERICA" FLOATING TRANSMITTER

No doubt most readers have read in the daily Press about the new floating transmitter which was to be used by the Voice of America in order to ensure that their programs could be heard in localities where at the present time reception is not possible from the normal fixed land stations.

THIS new floating radio station is aboard the ship Courier and, from reports received, it is now operating in the Canal Zone. In addition to powerful short-wave transmitters which can operate on any of the normal wave bands it also has a broadcast band transmitter which can also be used at the same time. of 150 kw while the two short-wave transmitters are 35 kw.

The Courier is at present operating on 9.7 mc and has been heard in the mornings at 9.0 and also in the afternoons till closing at 2.0 pm after a programme in Spanish and English. They ask for reception reports to be sent to them at PO Box 1016, Balboa, Canal Zone. According to the NZ DX Times they think the call letters of this station are KU2XAJ but this has not yet been confirmed. No doubt the ship, which incidentally is of 8000 tons, will move to a new location later when their signals may be logged at better strength.

RADIO CANADA

HERE is the latest schedule for Radio Canada showing not only the programs directed to Australasia but also those for Europe generally and other areas.

Australasian Service:

6.40 pm to 7.50 pm Wed. and Sun.; CKLO, 9.63 mc.

Caribbean and Latin American Service:

4.50 am to 5.45 am Portuguese; CKLO, 9.63 mc; CHOL, 11.72 mc.
5.45 am to 6.50 am, Spanish.
6.50 am to 7.05 am, French.
7.05 am to 7.34 am, English.
7.35 am to 7.50 am, Spanish (Except Sunday).
7.35 am to 7.50 am Dutch (Sunday only).
7.50 am to 8.40 am, Spanish.

North-west Territories Service:

9.15 am to 10.05 am, English and French, Sunday only, CKOB, 6.09 mc; CKLO 9.63 mc.

European Service:

11.00 pm to 12.05 am, Canadian Forces, Sat. only, ... CKLX, 15.09 mc CKNC 17.82 mc.
11.45 pm to 12.05 am, Canadian Forces, except Sat.
12.15 am to 2.30 am, Russian, Finnish, Swedish, Czech .. .. CKCX, 15.19 mc. .. CKNC 17.82 mc.
2.30 am to 6.0 am, German, Czech, English, Danish .. .. CKCS, 15.32 mc. CKNC 17.32 mc.
6.0 am to 6.30 am, German CKCS, 15.32 mc.
6.30 am to 6.45 am, Italian CHOL, 11.72 mc; CKCS, 15.32 mc.
6.45 am to 7.0 am ,Italian, CHOL, 11.72 mc.
7.00 am to 7.30 am, Russian CHLR, 9.71; CHOL, 11.72 mc.
7.30 am to 8.00 am, French
8.00 am to 8.30 am, Czech CKLO, 9.63 mc; CHOL, 11.72 mc.
8.30 am to 9.00 am, English, Sun. and Mon. only.
8.30 am to 9.05 am, English, except Sun. and Mon.
9.00 am to 9.30 am, Czech, Sun and Mon. only.
9.05 am to 9.15 am, French, except Sun. and Mon.
9.15 am to 9.30 am, German, except Sun. and Mon.

NEW SCHEDULE FOR RADIO SWEDEN

RADIO Sweden nave just sent us their new schedule which will be in effect for the months of May, June, July and August.

10.00 am to 12.45 pm, East. North America .. 11.88 mc.
10.00 pm to 10.45 pm, East. North America .. 15.155 mc.
2.00 pm to 2.45 pm, West North America .. 11.705 mc.
7.00 am to 8.00 am, West North America .. 15.155 mc.
10.00 am to Noon, South America .. .. .. 11.705 mc.
9.00 pm to 9.45 pm, South America .. .. .. 15.155 mc.
9.00 am to 10.00 am, South America .. .. .. 11.705 mc.
11.00 pm to 11.45 pm, Far East .. .. 15.155 mc.
9.00 am to 9.45 am, Far East .. .. 15.155 mc.
2.00 pm to 2.45 pm SE Asia and West Aust. 15.155 mc.
12.00 am to 12.45 am , SE Asia and West Aust. 15.155 mc.
12.45 am to 2.00 am, SE Asia and West Aust. 15.155 mc.
1.00 pm to 1.45 pm, Middle East .. .. 11.705 mc.
3.00 am to 3.45 am, Middle East .. .. 15.155 mc.
3.00 pm to 4.00 pm, Africa . 15.155 mc.
4.00 am to 4.45 am, Africa . 15.155 mc.

European Service:

5.00 am to 5.30 am, Swedish transmission .. 9.62 mc.
5.30 am to 6.00 am, German transmission .. .. 9.62 mc.
6.00 am to 6.30 am, English transmission .. .. 9.62 mc.
6.30 am to 6.45 am, French transmission .. .. 9.62 mc.

Swedish Home Service:

3.00 pm to 8.00 pm .. 6.065 mc.
3.00 pm to 7.00 pm, Sunday . 6.065 mc.
8.00 pm to 2.10 am .. .. 11.705 mc.
7.00 p to 2.10 am, Sunday . 11.705 mc.
2.10 am to 8.00 am 6 065 mc.

The Swedish Home Service is also broadcast over Motala, 12 kw on 7.27 mc.

Radio Sweden appreciates all letters and reports on reception of the above transmissions and these should be sent to Radio Sweden, Stockholm 7, Sweden.

STATION ADDRESSES

BUCHAREST	Societatea Romana de Radioifuziune, Bucuresti II, Strada A, St. Popov No. 41. Rumania.
LKV	Norsk Rikskringkastning, Suhmgatan 23, Oslo, Norway
OXI	Radiostation Godthaab, Godthaab, Greenland.
TFJ	Radio Station TFJ. Rikisutvaroid, Reykjavik, Iceland.
LEIPZIG	Mitteldeutscher Rundfunk, Springerstr, 24, Leipzig N22, Germany.
HIIG	Emisoras HIG, Calle Constitution, San Christobal, Domincan Rep.
COJK	Radio Station COJK, Finlay No. 4, Camaguey, Cuba.
TIPG	La Voz de la Victor, Apartado 225, San Jose, Costa Rica.
4VEH	Radio Station 4VEH, Box 1, Cap Haitien, Haiti.
XEHH	Sal de Uvas Picot, Zempoala No. 77, Mexico D.F., Mexico.
YSWW	La Radio del Pueblo, Santa Ana 4a Calle Poniente, Santa Ana, El Salvador.

FAREWELL TO RAY SIMPSON

With this issue, we say farewell to Ray Simpson who has, for many years, been the short-wave contributor to "Radio & Hobbies." Ray is no longer able to carry on in this capacity but we take the opportunity of expressing appreciation of his past efforts on behalf of both readers and staff.—Ed.

FLASHES FROM EVERYWHERE

PORTUGUESE INDIA: There seems to be a certain amount of mystery regarding Radio Goa as while some readers report hearing their signals on 17.89 mc, others in good locations cannot hear a trace of them. According to Art Cushen in New Zealand he has heard them on favorable days when they transmit a request program in English from just before 7.0 pm to 7.30 pm. A program summary is given at 7.15 pm when they gave their schedule as 11.30 am to 12.30 am on 6.02 5mc, 9.615 mc and 17.89 mc. At our location at time of writing there is no sign of Goa on any of these channels

PERSIA: One of Radio Australia's regular contributors to their DX session, Bert Bluman, of Israel, gives the following checks on regional transmitters. Tabriz, 6.092 mc, 12.30 am to 4.0 am, in Persian and Azerbaijani; Meshed, 8.015 mc comes on air around 11.30 pm and fades out about 1.15 am; Shiras, 6.845 mc, also comes on at 11.30 pm and their Persian—oriental program fades out around 12.45 am; Ishfahan, 7.96 mc is another to open at 11.30 pm but remains on until 2.30 am. Programs consist of French song hits with Persian lyrics as well as oriental type programs. This latter station uses a 12-tone interval signal and is sometimes interfered with by the Greek station at Kozani.

ISRAEL: The same correspondent gives Graham Hutchins some details of stations in his own country. 4XB21 which operates on 6.83 mc carries their B program from 4.0 pm to 4.30 pm, 9.45 pm to 11.0 pm, midnight to 2.15 am, 2.30 am to 4.30 am and 6.15 am to 6.30 am. English is heard at 9.45 pm and 6.15 am, French at 10.0 pm, Arabic at 4.0 pm, 10.15 pm, 2.30 am; Turkish at 4.0 am and Persian at 4.15 am. 4XB31 on 9.01 mc is on from 2.30 am to 5.0 am, 5.15 am to 8.0 am with English at 6.15 am and 7.15 am. 4XB44 on 6.725 mc gives Forces programs from 2.30 am to 6.0 am. Summer time was to come into effect on May 1 which means all programs will be presented one hour earlier.

THE HAM BANDS WITH BILL MOORE

The 22nd Annual Federal Convention of the WIA was held in Sydney during Easter, a most important event in policy making for the hobby. It is the first occasion since 1938 that the convention has been held in Sydney, being normally held in Melbourne.

DELEGATES from all States were present together with all members of the Federal Executive.

The terms of the various resolutions carried will be published in Amateur Radio and throughout the year the Federal Executive will act upon them.

The convention was under the chairmanship of the Federal President, George Glover, VK3AG, and the following officers were in attendance: NSW—Delegate Vaughan Wilson, VK2VW, observer John Moyle, VK2JU; Victoria—delegate Charlie White, VK3AUP, observer Len Jackson; Queensland — delegate Alex Burton, VK4FE; South Australia—delegate John Bulling, VK5KX, observer Jack Coulter, VK5JD; Western Australia—Delegate Ron Hugo, VK6KW; Tasmania—Delegate Bob O'May, VK7OM; Gordon Weynton, VK3XU, Federal vice-president; Max Hull, VK3ZS, Federal secretary; George Manning, VK3XJ, Federal treasurer; Bill Gronow, VK3WG, Federal publicity officer.

FOUR-DAY SESSION

The convention was in session for the four days over the Easter weekend, dealing with the 72 agenda items. It was a period of hard work for all in attendance.

The only relaxation enjoyed by the delegates was on the Saturday evening when the annual Federal dinner was held. George Glover, VK3AG, Federal President presided and besides the members participating in the convention, members of the NSW divisional council were present. Visitors included Mr T. Armstrong, Superintendent Wirless NSW; Dr. H. B. Wood, vice-president of the IRE; Wing-Commander C. Buiele, RAAF ;and Lionel Swain, VK2CS, president of the Hunter Branch, WIA.

Bill Gronow, VK3WG, proposed the toast of the PMG's Department, mentioning the co-operation always forthcoming from officers of the department, and the assistance rendered the WIA and radio amateurs in general.

Mr. T. Armstrong replied on behalf of the department and spoke in general terms of liaison with the WIA on amateur affairs. Mr. Armstrong is well-known to amateurs in most States.

Gordon Wynton, VK3XU, proposed the toast of the visitors ,and Wing-Commander Buiele replied. The latter stated that many of those present were well-known to him, as so many amateurs had served in the RAAF. He spoke too of the Active Reserve, in which it was hoped many amateurs would be joining.

Before the presentation of the Remembrance Day Trophy, a minute's silence was observed, in memory of those amateurs whose names and calls signs were engraved thereon. The Federal President then handed the trophy to the Tasmanian delegate Bob O'May, VK7OM. 1951 was the third year in succession that the VK7 Division had won the R.D. contest.

The Victorian delegate Charlie White, VK3AUP, thanked the NSW Division for the work performed to make the event a success and NSW President John Moyle, VK2JU, replied.

Max Hull, VK3ZS, Federal Secretary acted as toast-master for the evening and at its conclusion delegates adjourned for a further business session

NORTH COAST CONVENTION

THE North Coast (NSW) WIA convention held annually at Easter was well attended. Visitors to the convention could not fault the organisation, and all reported the event a great success.

Results of the many contests were as follows:—

Gerry Challender Memorial Trophy. 1st place—Harold Whyte, VK2AHA 2nd place John Meagher, VK2AMV. (Most station contacted on 7 MC in two hours final scoring adjusted on power basis.)

Urunga Scramble—1st place J. Vardy, VK2JK, 2nd J. Meagher, VK2AMV. (One hour's operation on any band any power.)

144 MC Hidden Transmitter Search—1st Peter Alexander, VK2PA, and Noel Hanson, VK2AHH, 2nd Alex Dan, VK2ABU. A second 144 MC search was also held and resulted in John Meagher, VK2AMV 1st, and Bill Brook VK2ACT 2nd.

Sid Daniels won the fishing competition, while Mrs. Meagher (2AMV) won the prize for identifying the greatest number of hams' voices. Mrs. Alexander (2PA) was the recipient of a prize for holding the lucky ticket, Mrs. Fisher (2DY) reseived a special award for making the greatest number of speeches!

Conditions experienced during the contests were not very good, static was heavy, and depite heavy rain in many portions of the State the weather was fine—during daylight hours anyway.

The convention provides the maximum interest for mobile workers and each year sees an improvement in the class of equipment on display.

Some very finely constructed complete mobile/portable stations were in operation, and many more amateurs were so equipped this year.

ANNUAL MEETING

THE annual meeting of the NSW division of the WIA was held in April The President John Moyle, VK2JU, occupied the chair and after formal business was concluded, Mr. Gil Miles, VK2KI, presented an extremely interesting demonstration, lecture and film show on the Radio Control of Model Aircraft.

Gil, of the Radio Research Board is a well known authority on the subject and with the aid of a model aircraft of some 9 foot wing span, which incidentally has flown more than 60 times, he demonstrated the methods of control using the normal field equipment. Members present greatly appreciated the opportunity of hearing such an able discourse on the subject.

The results of the annual ballot for councillors resulted in the election of the following members—Dave Duff, VK2EO; John Moyle, VK2JU; Fred Phillips, VK2ZQ; Wal Nye, VK2XU; Harry Powell, VK2AYP; Lyell Woolnough, VK2GW; and Vaughan Wilson, VK2VW;

Two councillors did not stand for re-election, they were Maurice Butler, VK2AAN, and Dave Evans, VK2AYE; both these amateurs served on the council for a number of years.

Maurice was best known for his able work in the disposal field, while Dave's activities were varied as he assisted greatly with the Division's AOCP classes.

The two new councillors need no introduction, they are Past President Wal Nye, VK2XU, and Divisional Sub-Editor for Amateur Radio Harry Powell, VK2AYP.

Brian Anderson VK2AND was elected honorary auditor for the ensuing year.

NEW OFFICERS

At the initial meeting of the Council the following officers were elected.—President John Moyle, VK2JU; Vice-President Lyell Woolnough, VK2GW; Secretary Dave Duff, VK2EO; Sub-Editor Amateur Radio Harry Powell, VK2AYP; 2WI Co-ordinator John Moyle, VK2JU; UHF Liaison officer Wal Nye, VK2XU; QSL officer Jim Corbin, VK2YC; Assistant Secretary Bob Winch, VK2OA; Class Supervisor Allan Appleby, VK2BF; Class Secretary Dave Evans, VK2AYE.

The contest committee appointed comprises—Wal Ryan, VK2TI; Ray Priddle, VK2RA, and Wal Nye, VK2XU. This committee acts, too, as the Federal Contest Committee in the terms of the Federal Convention decision.

The following Country Zone officers were re-appointed North Coast—Noel Hanson, VK2AJO; Western—Hugo Stitt, VK2WH, New appointments are Jim Eagling, VK2AJO—South Western and Eric Fisher, VK2DY—South Coast. The area covered by these two zones was previously controlled by Ray Rayner, VK2DO, who has resigned.

Dick Dowe, VK2RP, was re-appointed the Division's Librarian.

A number of positions are still to be filled and further appointments will be made at subsequent meetings.

NEW AMATEUR FREQUENCY ALLOCATIONS

AUSTRALIAN amateurs were circularised by the PMG Department announsing the change to Atlantic City Allocations on the HF bands from May 1st. The facilities were granted at the same time as they were made available to American and other stations. HF bands are now as follows:—3500—3800, 7000—7150, 14,000—14,350, 21,000—21,450 26,960—27,230 and 28,000—30,000 Kcs.

These bands are common to most countries in Zone 3 (Asia and Oceania), there are one or two exceptions in the zone, however.

You will remember the world was divided into three zones at Atlantic City for allocation purposes, and the band widths available to amateurs in the different zones varied somewhat.

Zone 1 (Europe, Africa, Near East, Asiatic USSR and Mongolia) allocations on the HF bands are similar to zone 3 in zone 2 (North and South America) the 3 5 and 7.0 Mc bands are wider. Frequency limits in these bands in zone 2 are 3500—4000 and 7000—7300 Kcs. The first shared with other services the second exclusively amateur.

The loss of 50 Kcs on 7Mcs will undoubtedly affect the week-end yarning between city and country stations as the band will be extremely crowded. This loss and the chopping of 50 Kcs from 14 Mcs will possibly upset the recognised CW and Telephony limits on these two bands. Some phone systems on 7Mc have already been heard advocating the taking over of the 50 Kc CW sector without any discussions on the subject.

The WIA will undoubtedly test the feelings of amateurs on the subject of CW allocations, and arrive at a new "gentleman's agreement" on these limits. Throughout the years, these agreements have proved remarkably effective—more so than anyone dared to imagine when they were first mooted.

In recent months due to the poor conditions prevailing on 7 MC, a number of stations have been conducting their daytime weekend yarns on 3.5 Mcs with excellent results.

During daylight hours static levels are low, and up to two hours after sunrise and two hours before sunset, the band provides good signals up to 300/400 miles and sometimes farther. During the middle of the day, at 100/150 miles signals often run at S9, while at 200/300 miles signals average about S5. The location and electrical interference of course can interfere with effective use of the band.

Providing city dwellers can cope with the BCI problem, the use of the 3.5 Mc band can relieve the interference problem on 7Mc.

WIA officials broadcasts will in the future be conducted on 7146Kcs in view of the new band limits.

DISPOSAL BARGAINS

RADIO BENDIX MN.26.C COMPASS RECEIVERS

ONLY A FEW LEFT

THE LAST OF THESE RECEIVERS THAT COST £286/-/-

The saving in cost on this purchase passed on to YOU. This is the finest broadcast receiver ever offered. 12 valve. Operates from 24V. Converts easily to 240V-AC also 6V, 12V or 32V.

COMPLETE WITH 12 VALVES and CONVERSION CIRCUIT

£15/17/6

LESS MOTORS £14/5/-
LESS VALVES £10/10/-

Completely converted, including Speaker, Dial and Control Panel, fitted, tested and Dial calibrated ready for use.

6V. D.C. Operation	£29/17/6
12V. D.C Operation	£29/17/6
24V. D.C. Operation	£24/17/6
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110V. A.C. Operation	£27/15/-
240V. A.C. Operation	£27/15/-

THE CONVERTED RECEIVER

with 55 to 1 ratio dial. 8" speaker in bakelite cabinet.

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Chassis fitted for S/W Converter

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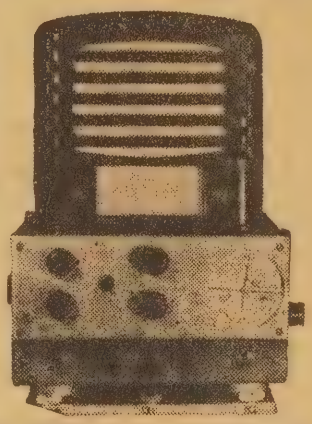
THE MOST SENSITIVE SET AVAILABLE IRRESPECTIVE OF PRICE



CONTROLS:
Volume, Sensitivity B.F.O. Tone & Tuning Wave Change Switch

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DIRECT RECEPTION of Europe, USA, and Asia on the Broadcast Bands.

VALVES USED 6J5 2 6N7 1 6F6 1 6B8 1 6L7 5 6K7 IF FREQUENCY 112KC.

Coverage 3 Band. 150KC to 1500KC. An outstanding receiver with a sensitivity of 1 microvolt. Ideal for home use, cars, boats or communications and amateur use as Q 5er on 455 or 1600 KC.

DURAL TUBING
9/16 to 12ft lengths
1" in 8ft lengths 1/-

NEW LOW IMPEDANCE HEAD PHONES
12/6
Used—Tested 7/6
Postage N.S.W. 2/6. Interstate 3/6

NEW 2" METERS
0 to 1 MA with Rectifier. 100V A.C. Scale
£1/12/6
50 MA, DC 19/6
Postage 1/-

NEW A.T.300 HF TRANSMITTER CHASSIS
Includes Power Supply, 60 Resistors, Cabinet, Oil Filled Condensers, etc. £1/-/-
N.B. Too heavy for distant buyers.

RELAYS
250 Ohm 4/6. 10,000 ohm 10/6.
Postage N.S.W. 1/-.
Interstate 2/-.

NEW 6V VIBRATORS
Gas Filled, Heavy Duty
15/-
Postage, N.S.W. 1/-.
Interstate 1/6.

NEW BLOWER MOTORS
Operate from 24V D.C. or A.C.
Ideal Hair Dryers, etc.
£2/5/-

American R.C.A. Indicator Units
For that C.R.O. Project. Perfect Order. Complete with Valves.
4 6AC7, 3 6H6, 1 5BP1
£8/15/-

Australian A.1 Indicator Units
Brand New. Complete with Valves
6 6AC7, 3 6H6, 1 5BP1
£9/17/6

NEW MIDGET 2-GANG CONDENSERS
F.N. Midcap .0004
6/9 Postage 6d.

NEW OIL FILLED CONDENSERS
1.5 Mfd, 4000V working
12/6

VALVES, NEW

6SH7	7/6
SH6	7/6
7193	5/-
6AC7	15/-
AV11	15/-
1P5	12/6
6K7	10/-
6N7	10/-
6A6	10/-
6L6G	15/-
6AK7	17/6

WANTED
Transceivers F56, 101, No. 11, 19, 22, ATR2B, etc. Also Communications Receivers, P.A. and Test Equipment. State price wanted and fair description of condition and completeness.

EXCELAIR RADIO

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AMATEUR OPERATORS EXAMINATION

SOME indication of the examination requirements for amateur licences in other countries can be obtained from the list of questions that follow. They cover one of the GPO's examinations last year in Great Britain.

Of the 55 candidates examined, 40 were successful, averaging 69 marks out of the possible 100. All questions had to be answered. They were as follows:— 1. What do you understand by the following terms; "Sidebands," "Carrier Wave," and "Percentage Modulation?" Explain with the aid of a diagram the "choke" method of modulation a radio frequency carrier wave at audio frequencies. (Average marks 11/20.)

2. Explain fully the difference between a "Rejector" and an "Acceptor" circuit, and give examples of their respective uses in receiving equipment. (Average marks 7/15.)

3. State the reasons for the employment of the pentode in preference to the triode for HF amplification. (Average marks 5/10.)

4. What are the conditions laid down by the Postmaster-General for the frequency control and measurement of amateur transmission. (Average marks 9/15.)

5. State fully what precautions should be taken at an amateur transmitting station to avoid interference with broadcast and television reception. (Average maks 7/10.)

6. Explain, with the aid of a diagram how a crystal may be used to control the frequency of a transmitter. State the advantages of crystal control. (Average marks 6/10.

7. When two resistances of equal value are connected in parallel across a battery of 24 volts, the total current flowing in the circuit is 2 amps. What is the value of each resistance. (Average marks 7/10.)

8. Describe with the aid of a diagram, the construction of a half-wave dipole aerial. Indicate a method by which the aerial is coupled to the transmitter, and show the current and voltage distribution in the aerial. (Average marks 7/10.)

During the year although some 500 licences were cancelled a net increase of 190 amateur stations was shown over the previous year.

TVI PROBLEMS

The March CQ editorial indicates that American amateurs are receiving much adverse publicity in the daily Press on the subject of TVI. They are receiving, according to experts, more than their fair share of blame for the strange figures appearing on the TV screens.

In some districts local city councils are even challenging the overall authority of the FCC by gazetting ordinances making it an offence to create BCI or TVI.

In one instance the City of Onawa, Iowa, passed the following ordinance; "It shall be unlawful for any person to use, operate, or maintain, any motor, machine, machinery, short wave transmitter, electrical appliance, &c., which shall be the direct cause of appreciable radio or television interference."

Maximum penalty 100 dollars or a term of imprisonment of not exceeding 30 days.

An interesting point that arises from the above and similar ordinances, is the fact that the overall regulatory powers of the FCC as generally accepted have never been challenged in court. Whether local authorities have the power to impose penalties for interference, will be undoubtedly the subject of litigation in the near future.

The familiar voice of Bob Dawson W4DSY will unfortunately be no longer heard on the 14 Mc band. Bob joined the ranks of "Silent Keys" on April 21st. W4DSY's signal around the long way was possibly the best reaching Australia and Bob had many good friends among VK amateurs. They will miss his cheery voice.

OFF THE RECORD — NEWS & REVIEWS

During the month, EMI officially notified the trade that in about six months time they would be releasing microgroove records in England and Australia. This period of notice was promised some little time ago in order to give all concerned a chance to prepare for the event.

THUS is answered one of the questions most often asked of recent years—in fact, ever since microgroove records were first released in America about four years ago, and in England about 18 months ago.

As far as official statements are concerned, there is virtually nothing more than the bare announcement to go on. I think, however, it is permissible to do a little guessing as to what the position might be. As one reader says, we might be wrong, but it's great fun.

First of all, it might well be pointed out that EMI is not a newcomer to the microgroove field. This company is world-wide, and includes the Victor company in America. It has come a long way since it was the Gramophone and Typewriter Company early in the century, in the days when a young and rising singer named Enrico Caruso asked—and got—£100 for making a few records, thus starting something which made millions for himself and for the company.

EMI has been making and selling microgrooves in both Europe and America for some time, and it should not be imagined in any way that it is starting out on six months' work to do the whole job.

It is rather more probable that the company is commencing six months of organising and planning for a sales and production campaign which will allow its dealers in all affected territories to offer EMI microgroove products to the public when D-day arrives.

It's only fair to say, too, that a task of this magnitude must be undertaken with great care, not only to protect the company's—and the public's—interests in their present investment, but to take in the new types without unduly dislocating a vast and expensive organisation. It is very much easier for a small company to break out into a big microgroove program than it is for a big one. We might regret the apparent tardiness of EMI in waiting so long, but we cannot but have some appreciation of their need to watch very closely the steps taken to bring about something which will virtually remake their whole future as it lies in records.

WHY 78?

Those of us whose interest in records lies more or less exclusively in the best type of reproduction and recordings are apt to be somewhat impatient of the reasons why 78's should be continued at all.

We don't quite see the point of using spring wound acoustic portables to play records, for instance, or why people should persevere with the old speed because they don't want to buy a new motor and pick-up. We are rather sorry that they don't know what they are missing in not completely accepting the new standards, and we are most anxious to see that in continuing to cater for 78's, record companies do not curtail production of the new records about which we are so enthusiastic.

I know at any rate that my own reactions tend to be a little this way, but the people who make the records are not likely to be so keen to agree, particularly in the ticklish period of building a new market to eventually replace the old, at the same time being forced of necessity to see that its trading position continues without damage.

WILL MEET DEMAND

It is, therefore, only realistic to say that EMI will continue to press 78 records just as long as the public wants them, and after all, its own sales figures are probably the only reliable indication of this. It's not always easy to pick one's way accurately between enterprise and indiscretion. I can only hope that, with the many problems which lie ahead, the company is able to fully cater for the new, while discharging what it feels to be its duty to the old.

It is the intention of EMI to press microgroove records here in Australia, and their manufacturing capacity is not limited only to the Sydney factory. The company is, however, faced with a most difficult position at the moment, and it is particularly unfortunate that its plans have to take effect at a time when many cards are stacked against it.

As mentioned in last issue, import

restrictions have drastically reduced the number of records which can come from England. In the immediate past, the company has been importing as many records as possible which have a reasonably steady sale, reserving its local capacity for producing discs of the more popular type which have such a short selling life as to make immediate pressing essential if the public is to have them at all.

Now, however, it is probable that a considerable part of its pressing time must be devoted to producing 78 records from the standard catalogue. Somehow or other this must be done wtih essentially the same facilities as are at present fully occupied with popular discs.

MICROGROOVE?

If to this is added the undeniably ticklish job of pressing microgroove records in quantity, one begins to develop a feeling of deep sympathy for the perspiring characters who have to face up to the situation and make something of it.

And it won't be much use allowing D-day to arrive without having microgroove records to offer the public. That would be something of an anti-climax which EMI would be most anxious to avoid.

They are faced, too, with the absolutely unqualified success of the Decca records which at the moment have a virtual monopoly of the microgroove market. Only this day, a check on the biggest retailer of these records in Australia confirms the view that microgroove is a terrific seller, and has opened up an enormous market. There is no essential sales resistance among the record dealers today on microgroove. They realise they have an absolute winner which they cannot afford to ignore, or fail to exploit.

The story, however, does not end with the records themselves. EMI are well awake to the fact that they must provide also the means to play them. This entails a complete line of pick-ups, motors and record-changers which will do justice to their new products. They must be able to offer facilities superior to any now offering on the market if their prestige, already somewhat dimmed by their late entry, is completely to recover. They have the resources to outbid any competitor if they can only bring them to bear.

NOT THE BEST

A review of the facilities for playing microgrooves at the moment reveals that these are not all they might be. We have a standard type of three-speed motor fitted with various types of pick-ups which, at today's prices, isn't too expensive, but which is far from being really good As a fitment to standard receivers, we have several types of crystal pick-ups which are quite good as such pick-ups go, but which are not up to standard for use with wide-range equipment. Even the magnetic pick-ups which can be bought have their several defects, and no one would say that they have achieved the same state of reliability possessed by the earlier types, despite the latter's poorer performance.

Really good pick-ups must be considered at the moment as being of the transcription type rather than suitable for general consumption. And of these, only a handful can claim flat and clean response over the full audible range. Mostly they have peaks inconveniently situated in the middle or upper middle range which make it impossible to achieve the full benefits of quiet surfaces and wide response of the records.

These are things which EMI is faced with at the moment, and the solution to which so many are anticipating.

No announcement is made as to which speed, if any, EMI will favor. My view is that they will produce records of all speeds according to the subject material, but I still have the feeling that the 45 rpm records will figure largely in eventual plans.

We might be able to get a lead from the USA, where both RCA and Columbia are reported to be ready with a new three-speed record-changer using a pick-up with two reproducing points. This is the first three-speed changer which either has produced to date. So far I doubt whether Columbia has made a changer at all, and RCA has spent millions of dollars in pushing their baby 45 rpm job. I would say it is highly probable that EMI will do the same, and make available both types of changers. I am quite sure they could do so if they so decided.

It is also interesting to read reports of advances made by RCA in using 45 rpm for long-playing records. Using the variable-grooving technique of adding more grooves per inch where practicable, they have apparently already succeeded in increasing the 5 minutes 20 seconds of their 45 babies to about eight minutes. This might be the answer to the problem of using 45 rpm and at the same time extending playing time on 12-inch discs to allow major works to be accommodated on single records.

BETTER 45's

It is quite clear that we must accept the fact of three speeds as well established, and that, for the moment, we must cater for them. On a long-term basis, however, this may not always be the case. There is a big argument for reducing this to a single speed—one of the ideas behind RCA's initial preoccupation with 45. Where they missed out was in not appreciating that uninterrupted playing was so important as to be a necessity.

For my part, I think it would be a good thing if ultimately we could achieve a single speed, and I wouldn't mind a record a little larger than 12 inches. I think, too, that if one speed were to be standard, 45 would be best all round. But this could only come if we can use it for both long and short playing discs.

If anyone could influence the market this way, it would be EMI and its associates. I am not suggesting that this is likely to be a feature of EMI's immediate actions. Their short-term policy must inevitably be based on a three-speed system, if only because their radiograms must be able to play competitor's records ts well as their own. But the possibility of some day simplifying their own operations by standardising on one speed can't be overlooked as a future development, even if viewed simply as a business proposition. It would make everything so much simpler and cheaper.

Around about October or November, therefore, I expect we can look forward to seeing tangible evidences of all these things. I cannot be too hopeful that EMI microgroove re-

(Continued on Page 101)

SALVAGING A DAMAGED PHOTO

This picture is typical of the type which the amateur may be asked to copy. It was specially valuable to the owner being the only one in existance, but the passage of time had produced the crop of spots, creases, and cracks which completely spoilt it.

After being treated along the general lines of this article it was virtually as good as new. Since most of the defects were in the background the figure was cut out and pasted on a new background, after which the few remaining defects were treated with pencil and brush.

This month we have some more to say about the use of the enlarger as a copying camera, with some points about salvaging old photographs and a rather unique method of making radio test instrument labels.

by Philip Watson

BEFORE delving into these matters, however, there is one more point which should be specially mentioned about the method of copying meter scales which was described last month.

Most meters, both local and overseas, are designed for scales with a 90 degree arc, but a few use a 100 degree arc. It is quite easy to recognise the difference once you know that it exists, an ordinary protractor or set-square in front of the meter usually being sufficient.

It is seldom that a 100 degree scale will be satisfactory on a meter designed for 90 degrees although, in some cases, it may be possible to extend the swing of the pointer by juggling the back zero adjuster, and to alter the sensitivity if there is a magnetic shunt across the poles. However, it is as well not to tackle jobs like this unless you know exactly what you are doing.

There is no reason why a 90 degree scale should not be fitted to a 100 degree meter and in this case the sensitivity can usually be corrected by a suitable external shunt. Whether these modifications are worthwhile will depend largely on circumstances, but may be justified if a scale cannot be obtained in any other way.

Last month's article mentioned briefly the idea of copying existing photographs for which no negative was available and particularly the salvaging of old and damaged photographs. The latter present an interesting challenge to the skill and ingenuity of the amateur and it is surprising what can be done with a little care.

First thing to decide is whether to attempt to retouch the original or whether to copy it and retouch the copy. Although the latter process has some disadvantages these are largely outweighed by the advantages and, for the beginner at least, is much to be preferred. Main advantage is that one avoids all risk of damage to the original, something which could be extremely embarrassing when, as is usually the case, this is of considerable personal value to the owner.

Thus a beginner, relatively unskilled with pencil or brush and who would be very unwise to attempt work on an original, may attack a

copy without any inhibitions, secure in the knowledge that even in the event of complete failure no real harm has been done and the only real loss is one of time and material. Further, he has a chance to try again, for there is no reason why any number of prints should not be made from the first copy negative.

The disadvantage of retouching a copy is that the copying process has to be carried out twice, once to make the copy for retouching and again to make the final print. Since there is some tone loss with each copy it may be necessary to strengthen some of the shading at the same time as the first copy is being retouched.

LARGE COPIES

On the credit side again is the ability to make the copy larger than the original and, in fact, it should be made as large as possible. In this regard one will have to consider the sizes of the dishes available, the size print which can be copied successfully and the higher costs per packet of very large sheets of paper.

Ideally the enlargement should be carried to the point where lack of detail is beginning to become apparent, since far less skilful handwork will be required under these conditions than would be the case on a smaller print. When the final print is made from this retouched copy, the reduction back to the original size, or even slightly smaller, will help considerably in masking the handwork.

Originals which are stained or yellowed with age can usually be considerably improved in the copying by the use of suitable filters, while mechanical damage, creases, cracks, indentations, &c., can often be masked by careful lighting, thus saving a lot of handwork.

Normally a yellow filter, such as a Wratten K2 or Ilford Alpha or Delta, will cope with such cases, but a foreign stain, as from inks or dyes, will call for a filter of the same color as the stain. This is always assuming that the stain is transparent, for little can be done if it is opaque.

When the best possible negative has been made, prints should be prepared on a smooth grade of paper (not glossy) which will take pencil and color readily but which does not introduce any appreciable texture. Kodak White Smooth Lustre (code letter "N"), or similar, is recommended.

RETOUCHING

Now comes the actual job of repairing the damage. For darkening the surface, a lot of work can be done with pencil, the exact choice of grade depending on the particular requirement. Grades range from 6H, which is extremely hard, through decreasing values to H, then HB, B, and increasing values of B to 6B, which is extremely soft.

The softer grades are useful where it is necessary to cover relatively large areas without particular need for sharp outlines, as, for example, when simply filling a white blotch on a dark background. Here the main requirement is to match the existing tone and merge the two together, and a sharp outline is not usually involved.

On the other hand, fine detail, such as in the features, requires very careful handling, and it is better to pick out the actual outline with one of the harder grades which will retain a sharp point and deposit only a minimum density. Once the outline has been correctly placed, softer grades may be used to work inside it, or the same grade may be used if only a light shading is required.

It is better to commence with a grade which is too hard and build up density with successive applications, than to start with a soft grade which results in too heavy a deposit at the first application. Errors can be corrected with an art gum eraser, but it is difficult to remove heavy deposits of pencil without smudging.

Dark areas, black spots, &c., which have to be lightened, can be treated in two ways. One is to scrape the spot with a sharp razor blade (this applies mainly to very small areas) and then, if necessary, darken it again with pencil to match the surrounding tone. This technique is best applied to relatively unimportant areas such as the background.

The other is to mix black and white color to match the tone and apply it with a fine brush. This is generally to be preferred when fine detail is involved. Ordinary black and white water-colors may be used or Process White may be mixed with Indian Ink. Indian Ink alone is also useful for matching very dark areas which cannot be treated with pencil.

The surface of a dry print will not normally "take" water-color, behaving much as though the surface was greasy. This is overcome by first moistening the surface with plain water until it begins to absorb it, after which it will be found that the color will flow quite smoothly.

WET WORKING

If a lot of brush work is to be done on a print it may be advisable to follow the technique used when coloring prints, and soak the whole print in water first. However, this is likely to loosen any pencil work already done, and this phase of the work would be better left until the print is dry again.

There is also the disadvantage that the print will have to be carefully dried if it is to remain flat, which is essential for subsequent working and copying.

Where only small areas are involved it is usually satisfactory to apply a small, moist pad of cotton-wool which will make the particular spot just sufficiently moist to accept the color. Some practice may be required with this technique in order to apply just the correct amount of moisture, and care must also be taken to avoid damaging any previous pencil work. If there is any such risk it may be better to leave this until last.

Good quality brushes are essential for satisfactory work, particularly where fine detail is involved, and a Winsor and Newton No. 0 or No. 1, series 16, is a very suitable type. Since such brushes are not cheap, they should be carefully washed and shaped after use in order that they may give continued satisfactory service.

It must be realised that the tones need to be carefully matched and that subsequent copying will only help inasmuch as it reduces the image and permits the use of controlled lighting.

The masking of handwork by increasing the contrast, as in the case of line drawings, is not possible in this case since it is most important

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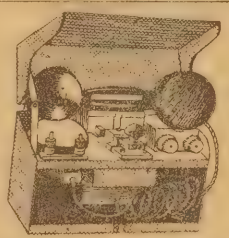

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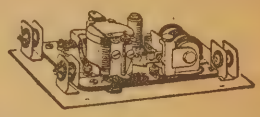

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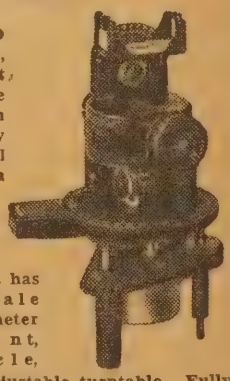

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to retain all the original tones and, if anything, the final contrast may have to be reduced slightly. However, slight differences in texture, such as a gloss from the pencil tones, are usually only visible when viewed at a critical angle and will not show up under normal lighting, although it is a good idea to check this point on the ground glass.

The above covers the major points involved in work of this kind though, quite naturally, it is impossible to cover all aspects, many of which will depend on the skill of the individual. Nevertheless, it should provide a starting point from which you can develop a technique best suited to your ability.

INSTRUMENT LABELS

As we also hinted last month, it is possible to use copying facilities to manufacture one's own instrument labels for home-made test equipment, amplifiers, communication receivers, &c. Although the process is more involved than that of simple hand lettering on a piece of card, it has the advantage that a little care can produce a really professional job — something which the average person cannot hope to achieve with hand lettering.

Most people, with very little practice and using ordinary drawing instruments, can produce a neat job as far as straight lines, arcs and calibration points are concerned, but run into trouble when they attempt the actual letters and figures. It is here that the copying facilities are so valuable, making it possible to paste on printed figures and letters and then copy the drawing without the patches showing.

Copy for labels on switches, volume controls, &c., can be set up directly on the drawing-board, the various dimensions and positions of markings being quite easy to calculate. It is very much easier if the ratio of reduction is a whole number, making it a simple matter to multiply the dimensions taken from the components. A good all round figure is two to one, but three to one may be used if it is not likely to make the copy unduly large and difficult to illuminate evenly.

According to the amount of reduction intended, so must the lines of the drawing by increased in width, otherwise they will be much too fine in the finished label. Details such as this are something which will need to be finalised by experience, but it is usually possible to judge the final effect by viewing the copy at a distance, when gross variations in line width or unsuitable type sizes will be more readily apparent.

LAYOUT CALCULATIONS

When locating switch positions remember that these are normally 30 degrees apart and this angle may be obtained from an ordinary 60 degree set-square. The radius on which these points should be located can be obtained by doubling the radius of the pointer knob to be used. Most potentiometers rotate through 270 degrees, which is just 90 degrees short of a full circle.

Don't forget to clearly mark holes which are to be cut out, as this makes things very much easier when mounting the finished label. If there is any chance that the label can also be used as a drilling template carefully mark the centre of all holes with fine, crossed lines, but don't rely on pencil lines as they will probably vanish in a high contrast copy.

In the case of dials involving continuous calibrations as on a communication receiver, signal generator, or audio oscillator, the calibration points do not follow any simple law and it is not possible to lay everything out in advance on the drawing-board.

In these cases a "same size" drawing is first prepared, having all markings other than the actual calibrations. This is then fitted to the instrument and the calibration points marked on it as they are plotted. These can be in pencil initially, with pencilled figures opposite the major divisions so that there is no chance of error when the scale is removed for finishing.

FINISHING TOUCHES

This consists of inking in the calibrations, tidying up any rough lines or errors with process white and the pasting on of the figures. Finally the work is copied and a print the same size made by enlargement. As a result there is no reduction of the original copy, which means that the drawing needs to be more carefully done than in the previous case.

It is still possible to retain the advantages of reduction in these cases, however, if one is prepared to undertake another operation.

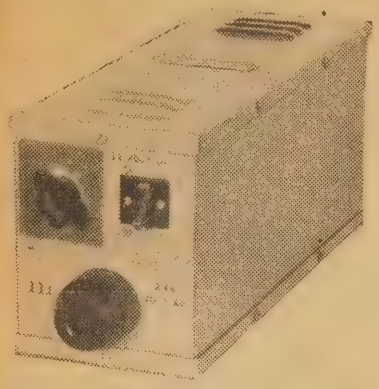
To do this, the original scale is finished to the point where all the calibration markings are inked in, but without the figures pasted on. This is then copied, and a print, as large as practicable, is made with considerably less than normal exposure, so that there is only a faint, though quite readable, image of the lines and graduations. On this print, and over the faint markings, a new drawing is laid out and the figures pasted on.

When finally reduced to the required size the quality will be much improved.

The best print surface for taking drawing ink appears to be a glossy one, although a smooth matt gives quite good results; but, naturally, the rougher surfaces are to be avoided. However, it is a good idea to wipe the glossy surface before attempting to draw on it, as fingermarks, &c., will repel the ink.

Since there are quite a number of steps involved in this last process there may be many who will con-

ELIMINATE YOUR BLACKOUT PROBLEMS!



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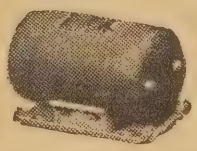
Suitable for loads up to 200 watts. Excellent frequency stability. Radio interference suppressed. 3 pin power outlet socket.

Price £28/10/0

Suitable for emergency lighting or in conjunction with Radios, Radiograms, Portable Amplifiers, Tape Recorders, Synchronous Motors. Completely shielded in metal case 5 x 6¼ x 13 inches. Unpacked weight 19lb.

TRADE INQUIRIES INVITED.

GENEMOTORS



Midget type as illustrated input 28 volts, output 250V at 60mA. 35/-
28 volt input, output 330 volts at 135mA. Filtered 70/-
TR1133 type, input 12 volts, output 300 volts at .24 amps, 150 volts at .01 amps, 6 volts at 5 amps. Filtered 90/-
12 volt input, output 250 volts at 100mA. 55/-
6 volt input, output 250 volts at 100mA. 90/-
No. 11. H.P. unit, 12v input, 340 volt, 40 mA. output filtered .. 35/-

SANGAMO PRECISION TIMERS

48-hour jewelled movement. Can be run continuously or for one minute periods. Ideal for photographers, hobbyists, electrical Flashes, Signs, &c. **22/6**
Packing and Postage: NSW 2/-, Interstate 3/6.

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12v 750 watt. Ideal Homelighting, Battery Charging, etc.
PRICE, £11/10/-, F.O.R.

IMA METER RECTIFIERS

FULL WAVE BRIDGE TYPE
Ideal for AC Meters and Multimeters, etc.
PRICE, each **15/-**
Full wave bridge copper oxide 100MA 4/6
Full wave copper oxide, 100 mA .. 3/6
Half wave selenium 5mA 3/6
Westectors full wave 5/6
Postage, 6d each.

HIGH POWER I.R.C. RHEOSTATS

250 ohm. 25 watt.
10 ohm, 2½ amp; 25 omh, 1 amp. Price, each **12/6**
Packing and postage, 1/- each.

24-VOLT MIDGET MOTORS SHUNT WOUND

Fully Laminated Fields Wound Armature. May be operated from AC at a slightly higher voltage. Sixteen Segment Commutator, ball-bearing Armature. Ideal for Model Trains, Hobbyists, etc. Condition New.
Price, each **39/6**
Packing and postage: NSW 1/6; Interstate 2/6.

SPECIALS

TR1133 Transceiver, 90-130, with valves, less power supply, each £10/10/-
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ZB2-ARRI U.H.F. Receiver 234-258 mcs, 4 valves, complete, new. £4/15/-
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Each 1/6
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Ceramic Formers 6 x 1¾in dia., each 3/6
Ceramic Formers 6 x 3 in. dia., each 5/-
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Pressure Gauges, 2½ inches, 3000lb. sq. inch, each 25/-
2" ribbed ceramic standoff insulators each 3/-
4½" x ¾" ribbed spacers ceramic, ea. 1/6
USA type M-100 Morse Keys, new 25/-
"A" Chokes, heavy duty, 25 amp. ea 7/6
RCA type ARB Receivers, 195 Kcs-9.05 mcs £19/17/6
Control Unit cases 7¾ x 8¾ x 10¾ 7/6
4 position Fuse Boxes 5/6
12 volt Vibrator supplies 110 volt 100 mA., output DC. £2/15/-
24 volt Vibrator supplies 135 volt 50mA output, regulated £4/10/-
All above plus postage, please.

CONDENSERS
(Paper Filter Oil Filled)

10mfd	400vw	8/6	1 mfd	1000vw	6/-
8mfd	1000vw	25/-	0.5 mfd	3000vw	7/6
8mfd	750vw	7/6	.25mfd	3000vw	7/6
5mfd	350vw	6/-	0.25mfd	1000vw	2/6
2mfd	2000vw	20/-	0.1 mfd	3500vw	7/6
2mfd	1800vw	20/-	0.1 mfd	2000vw	6/-
2mfd	1000vw	12/6	0.02mfd	8000vw	4/-
1mfd	2000vw	10/-	0.01mfd	5000vw	4/-

ELECTROLYTIC TYPES

1000mfd	12PV . 3/-	200mfd	100PV . 5/-
500mfd	15PV . 3/-	50mfd	50PV . 2/-

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6AG7	20/-	9001	10/-
6H6GT	7/6	12A6	10/-
6SH7	8/6	12SG7	10/-
6SH7GT	8/6	12SK7	10/-
717A	15/-	12SR7	10/-
954	12/6	CV6	5/-
955	12/6	EA50	7/6
956	12/6	VT90 micropup	10/-

NEW VALVES

1K5G	7/6	6SQ7	12/6
1R5	12/6	6X5GT	12/6
1S5	12/6	7193	7/6
3A4	12/6	7A6	10/-
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6H6	10/-	1294	11/6
6J5G	11/-	VR54 EB34 ..	5/-
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METERS

0-10 mA., DC, 2in round flush new 22/6
0-30 mA., DC, 3in round flush .. 25/-
0-30 volt DC, 3in round flush with datum indicator 30/-
0-300 mA., thermocouple. New .. 15/-
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0-4 Amp., RF, thermocouple. New Imported 2in square flush 17/6
20 mA., DC, 300 amp. scale, 3in. round flush 25/-
20 volt DC, 2in square flush, imported. New 20/-
40 volt DC, 2in square flush, imported. New 20/-
0-500 mA., RF Meters. 2in flush .. 17/6
20 volt and 200 volt DC, 2in round dual reading, with leads. New 20/-
Packing and postage, 1/6 each.

Please add exchange to all cheques. Make money orders and postal notes payable to Lewisham. Sorry, no C.O.D.

ELECTRONIC EQUIPMENT CO.

29b WEST ST., LEWISHAM, SYDNEY LM3555

We do not accept responsibility for any order damaged in transit.

sider it is not justified, and this may well be so if a good original drawing can elminate the need for reduction, particularly as even the simple process will give better results than freehand printing.

An alternative method of making labels, and one which we believe to be unique, provides a number of advantages over that just described, though it has the disadvantage of being mainly applicable to small labels.

In this case the copy is prepared as before, but instead of making a print to serve as a label, the original negative is used directly. This naturally limits the size of the label to the size of negative which the enlarger will take, and generally confines it to one which is suitable for a single control knob.

LACQUER COATING

The negative is made suitable for viewing by reflected light by the simple procedure of applying a coat of white lacquer to the emulsion side, it then being viewed from the celluloid side. The lacquer provides a reflecting surface, and the lines appear white against a black background.

This arrangement has a number of advantages. First, the label is correct reading (from left to right) when viewed from the celluloid side, so that this relatively tough surface is presented to the wear and tear, plus the fact that a celluloid scale is tougher than a paper one, anyway.

Second, the natural curl is toward the panel, not away from it, as in the case of paper, and a single-hole mounting will usually suffice.

Third, although white is suggested as a backing color, other colors are suitable and may be used to pick out a particular value or calibration point. Finally, only one photographic operation is required to produce the scale.

Primary requirement for a good label by this method is correct exposure. This must be such that the black lines of the original produce no density whatever in the negative, being represented by clear celluloid only. If any density is allowed in these parts, whether it be due to exposure, fog, or any other cause, the whites will be seriously degraded. On the other hand, the blacks need not have a maximum density by transmitted light in order to produce a good black when backed up with paint.

Some idea of how a negative is going to behave when painted can be obtained by locking it in a printing frame with a piece of white paper behind it.

The method of applying the lacquer is not particularly critical, as the surface being viewed is in contact with the emulsion and will take on the same smooth surface. Various colored lacquers may be obtained from model aircraft supplies, while nail lacquer is an excellent and convenient source of red. No particular skill is required to pick out a group of letters or figures in a distinctive color, it being only necessary to apply a blob of the required color and see that it does not spread to an adjacent group.

CHECK SIZE

The size of the image will have to be checked on the ground glass when the gear is being set up, as there is no second operation to permit final size adjustment. This is most easily done by checking a critical dimension with a pair of dividers or aganst two marks on a piece of cardboard.

In the case of smaller labels, such as those required simply to identify a control or set of terminals, it is possible to set up the copy for several at one time and make them all on one sheet of film, subsequently cutting them to the required size. These small labels may be attached either by a small nut and bolt at each end or one or two dabs of model aircraft cement, the latter often being the more convenient.

ULTRAFAX—VIA THE MOON

(Continued from Page 5)

present. The aim of the first presentation was to prove the ability of Ultrafax to transmit at the speed of light—186,000 miles a second — a wide variety of graphic material, including charts, fingerprints, news and advertising layouts, and items ranging from historical documents to complex atomic formulae and battle maps.

A striking feature of the demonstration came when the 1047-page novel Gone with the Wind was transmitted, word for word, in its entirety—from the transmitter to the receiver. Many of us still remember the time when we first read this book and how much it took us to plough through this effusive novel. Well, the entire three million words of Gone with the Wind was flashed in 2 minutes 21 seconds . . .

At this initial presentation, which lasted over an hour, the Library of Congress also provided some material for transmission. Among the original historical papers transmitted were: The original document of Japanese surrender; the American Declaration of Independence in the handwriting of Thomas Jefferson; the first map of Washington.

And finally, marking two of the most significant affirmations of man's progress, a page of the Gutenberg Bible and the preamble to the Charter of the United Nations were transmitted.

The unveiling of Ultrafax took place near the site where Professor Samuel F. B. Morse first demonstrated his telegraph—104 years ago.

OFF THE RECORD

(Continued from Page 95)

cords will be plentiful for a start, unless the company is able to work miracles in the meantime with its resources and raw materials. It will, however, have an enormous field of music and musicians to draw upon, and is undoubtedly poised to deliver outstanding records.

I have already commented upon the superlative quality of some RCA discs I have heard, and see no reason why this standard shouldn't be maintained or improved upon under the HMV and associated labels. It is only reasonable to assume that EMI will start out with some hand-picked examples of what they can do. I for one am looking forward to hearing them.

TWO-NOTE DOOR CHIMES

(Continued from Page 88)

tive affair can be made up of sheet metal.

The advantages of this unit have no doubt occurred to the reader. Simplicity and cheapness are obvious. Battery economy is another. The power consumed is appreciably less than for a similar solenoid unit, one reason being that there is no friction other than air to be overcome. So the impedance can be higher and current lower. Another advantage is that it can be made up in an evening or two.

FINISHING TOUCHES

The bell mechanism may be on hand or suitable materials from which it could be made. Alternatively, you may have to buy a suitable bell from an electrical appliance store and also "shop" around the hardware stores for suitable metal tubing.

Things like the radio terminal heads and piano wire scraps can usually be picked up as "junk" from repairmen who deal in these things.

The ultimate finish can be a matter of taste ranging from a wooden hood over the mechanism, with polished brass tubes to an all chromium-plate finish. Either way, you will like the final result.

ANSWERS TO CORRESPONDENTS

T.D.O. (Nth. Brighton, Vic.) sends in a further 12 months' subscription and at the same time has some complimentary remarks to make about the magazine.

A. Thanks for the sub. which has been attended to and we trust that you will find as much pleasure in radio during the next 12 months as during the past.

K.M.G. (Pascoe Vale Sth. Vic.) writes to advise of his correct address and at the same time makes the suggestion that we describe a remote control tuning system suitable for a domestic receiver. The idea is to allow the receiver to be tuned from a number of remote points.

A. Your new address has been noted. Thanks for the suggestion. It is one we have considered but have so far rejected because most satisfactory remote control systems depend on a complicated mechanical system which must be adjusted to a high degree of precision. There is a scheme which was brought to our attention recently which may offer a part solution to the problem but we are not in a position to make any promises at the moment.

M.McP. (SS River Clarence) acknowledges receipt of circuit data and comments favorably upon the standard of the magazine.

A. Pleased to note that the details which we forwarded to you was what you wanted. Your appreciation of R & H designs is evident in the number of such sets which you have built up. Thanks for your expressions of appreciation for the contents of the magazine. We hope that the standard will continue to meet with your approval.

F.O. (Bunerong, NSW) wants to know where he can buy a short wave receiver as distinct from the dual wave variety normally used for domestic listening.

A. The type of set you require is probably what is known as a communications receiver, of which there are a few available, but the demand is limited. We suggest that you contact some of our advertisers, particularly those who are acting as agents for overseas manufacturers, and give them some idea of your exact requirements. The price of such sets is likely to be high and many enthusiasts prefer to build their own for this reason. Some suitable circuits are available in the Radio and Hobbies Shortwave Handbook, available from this office, price 2/-.

A.W.G. (Beerwah, Q.) forwards a subscription to Radio and Hobbies and has some complimentary remarks to make about the magazine as well as some suggestions regarding the type of articles he would like to see.

A. The subscription has been sent to the appropriate department from which you should receive a receipt direct. Many thanks for your kind remarks and we hope that the magazine continues to please you as it has in the past. We are hoping to do something along the lines of additional transmitter articles, while the present series should provide some useful information for those, like yourself, who are interested in the ham ticket.

T.W.L. (Dooen, V.) wants to use a 32L7 valve in an AC/DC receiver to operate on both 110 volts and 240 volts and wants to know if this valve will stand the overload without serious shortage of life.

A. Although we have no exact details we would not like to advise an overload of this order. One solution would be to use a 110 volt transformer at the AC site from which the set could be operated in the normal way. Another method which is cheaper as regards first cost but more wasteful of current is to drop the voltage to the set through a suitable resistor. In any case the 32L7 is not a recommended type and, if available at all, may still not be easy to replace if necessary. No mention has been made of the effect of line voltage change on the filament supply either on this or the other valve and they would certainly not stand this for very long.

A.C.G. (Wagga, NSW) writes at some length about the problems of becoming an amateur and raises a number of very interesting questions.

A. We are afraid that space and time does not permite us to deal with all your questions as fully as we would like. However we may be able to publish some articles in the near future which will cover most of these points in greater detail. Briefly, however, the position is this: A transmitter of 30 watts input is quite capable of providing world-wide communications providing (1) that it is equipped with an efficient aerial, and (2) that the correct frequency is chosen for the prevailing conditions, i.e., distance, time of day, time of year, effect of sunspot cycle, &c., and it is a knowledge of these things which enables an amateur to obtain good results from relatively simple equipment. You appear to be under the impression that satisfactory results are possible with an inefficient aerial simply by feeding a lot of power to it from the transmitter. Actually the reverse is more nearly correct and it is essential to provide a correctly designed aerial if any use is to be made of the available power. In any case ,the power is limited by the authorities to 100 watts and this must be used efficiently if the best possible results are to be obtained under all conditions. There have been many different types of test equipment described in Radio and Hobbies at various times and these circuits are on file if you care to advise us which ones interest you most.

H.T. (Singapore, British Malaya) enquires about the current consumption of the VTVM mentioned in the recent Serviceman article and also forwards another circuit with the suggestion that an ohms circuit might be added.

A. The current consumption of this instrument would be only a few milliamps but the original unit used the nearest commercial transformer which had a rating of 40 mA. The circuit was originarlly published in September, 1949, and the parts list, photographs and circuit are available through our 2/- query service. The circuit you submit appears to be more complicated, using four valves and several switches, without providing any special features. In addition the use of batteries is often inconvenient and expensive.

R.W.H. (St. Helens, Tas.) is interested in the Karset and raises a query about the possible effect of varying bias, due to varying oscillator grid current with frequency, on the sensitivity of the receiver.

A. It is true that the grid current will vary slightly, and the bias also, but the practical effect is negligible. The sensitivity of this set is such that it should be capable of receiving any station which is audible above the prevailing noise level and we do not think there would be anything to be gained by the alterations you suggest. It must be realised that once a certain sensitivity has been reached there is no point in increasing it further, since all additional signals would be below the atmospheric noise level. We do not anticipate describing a dual wave version of the Karset, unless there is a particular demand for it, and this does not appear to be the case at present. We note the matter you have raised regarding Calvin Walters article and we have passed your letter on to him for his comment. Many thanks for your kind remarks about the magazine and we hope it will continue to please you.

A.H. (Epping, NSW) is trying to decide whether to build the Multie-Talkie or the Carry Set, and raises some points about the two sets.

A. The circuit of both these sets is very similar and the performance, likewise, should be of the same order. The main difference was that the Carry Set was built into just about the smallest cabinet that it was possible to use while the Multie-Talkie was not quite so compact. Considering all the points you raise, it would seem that the Multie-Talkie would be most suitable for your needs and you need not fear that you would lose anything in performance as a result. However, we could not recommend either set for use as a regular car receiver. The voltage peaks might cause trouble in the valves and it is also likely to suffer from serious ignition interference with the engine running. The Carry Set was not designed to operate from the Multie-Talkie vibrator supply.

A.W.F. (Neutral Bay) queries the connection between contacts 2 and 3 on switch No. 3 of the No. 2 Control Unit (December, '51, page 65).

A.: You are quite correct, A.W.F. This was an error, though fortunately a rather obvious one, and we have drawn attention to the fact in an article which will appear in the May issue. Many thanks for drawing our attention to it.

THE "RADIO & HOBBIES" QUERY SERVICE

ALL queries concerning "R & H," designs, to which a POSTAL REPLY is required, must be accompanied by a postal note or stamps to the value of TWO SHILLINGS.

For the same fee, we will give advice by mail on radio matters, provided the information can be drawn from general knowledge. UNDER NO CIRCUMSTANCES, however, can we undertake to answer problems involving special research, modification to commercial equipment or the preparation of special circuits.

Whatever the subject matter, we must work on the principle that a letter is too involved if the reply takes more than 10 minutes of our time.

Queries not accompanied by the necessary fee will be answered FREE in the columns of the magazine and presented in such a way as to be of interest to other readers.

To those requiring only circuit reprints, &c., we will supply for TWO SHILLINGS diagrams and parts lists from our files covering up to three "R & H" constructional projects. Scale blueprints showing the position of all holes and cutouts in standard chassis will now be 3/6. These are available for nearly all our designs.

Address your letters to The Technical Editor, "RADIO and HOBBIES," Box 2728C, GPO, Sydney.

Note that "RADIO & HOBBIES" does not deal in radio components. Price quotations and details of merchandise must be obtained direct from our advertisers.

T.L. (Perth, WA) asks if there has been a second edition of the Australian Hobby Handbook published. He is a radio beginner and found the radio section of the first edition very interesting

A.: No, T.L., we have not yet published a second edition of the Hobby Handbook and have no immediate plans for doing so. However, we suggest that you study the Learn While You Build It series which started in the March, 1951, issue of Radio and Hobbies and is still current. The articles are especially designed for beginners and approach the subject from a practical point of view

N.B.E. (Rotarua, NZ) wants to build the "1951 Super Six" but is worried about the suitability of the tuning condensers available in New Zealand.

A.: The figures you quote are very similar to those used in Australia but in any case the important thing is to use a dial and coils to suit the gang and this does not affect the design of the circuit to any marked extent. There does not appear to be much point in designing a set with greater gain than this receiver, or others like it, since such a set will receive any signals that are worthwhile hearing about the natural noise level and no improvement results from greater sensitivity. The coils should be satisfactory with the 6J8 valve, or you could use the 6K8 if you prefer.

A.W.F. (Alice Springs, NT) forwards a subscription and inquires about back issues containing details of radio controlled model aircraft.

A.: We have passed your subscription on to the appropriate department together with your request and no doubt they will be able to adjust the matter for you. We regret that the issues you require are no longer available from this office and your only chance would be to borrow them. They are September, October, and November, 1950. Many thanks for your kind remarks about the magazine.

R.W.H. (St. Helens, Tas.) suggests that we publish an article on the installation of the 1952 Kar Set.

A.: As you probably know by now, R.W.H., such an article appeared in the April issue, but thanks for the suggestion just the same.

J.McK. (Toorak, Vic.) wats to know if we can supply any details of the Field Strength Meter Monitor which he has seen advertised in Radio and Hobbies.

A.: The device is really a simple receiver intended to measure field strength of VHF transmissions and would be useful mainly for the parts, although modifications to the frequency coverage would make it suitable for checking amateur transmissions. Most of the other relevant information is contained in the advertisement.

R.B. (Yarraville, Vic.) is anxious to obtain a circuit of ex-disposals receiver type R1125A either to purchase outright or to borrow for a short period in order to make copies. He suggests that some other reader may be able to help him and we are publishing his name and full address to enable them to contact him direct. It is: Mr. R. Belfrage. 13 Powell St., Yarraville. W13, Victoria

E.A.C. (Blakehurst, NSW) is anxious to build an oscillator and learn something of its use for testing receivers and wants to know which particular circuit we would recommend. He also makes some suggestions for an article and submits an idea for the Reader Built It page.

A.: We would suggest that the simple oscillator described in Radio and Hobbies for May, 1947, would be best suited to your requirements and if you do not possess this copy we can supply circuits and other data. A chassis blueprint is available but no under-chassis wiring diagram was published for this instrument. Oscillators are used for fault-finding in the way you suggest and once you have one to work with we think you will develop a method of working with very little practice. We may be able to do something along the lines of the detector article and we have passed your suggestion on to the Reader Built It department.

T.P.G. (Harrow, Vic.) has had pickup terminal fitted to a commercial vibrator set but complains that the volume is insufficient and that the volume control has no effect on the pickup circuit.

A.: We do not keep circuits of commercial sets and we regret that we have no knowledge of the particular model you mention. This makes it rather difficult to decide exactly what your trouble may be, but we suspect that the pickup has rather a low output, which is characteristic of this type, and may really require some form of preamplifier for best results. In most circuits the volume control operates in the grid circuit of the audio amplifier valve and can be made to serve the pickup by arranging that the "hot" end be switched from the detector circuit to the pickup terminal It is probable in your case that the terminals have been connected directly to the grid circuit.

A.H.W. (Forrestville, NSW) writes to tell us that he is very keen on the idea of the amplifier handbook and makes some suggestions regarding the type of material he would like to see included.

A. Many thanks for your comments A.H.W. and we will keep your suggestions in mind when we go farther with the project. It is not likely that the price will be beyond the purse of our readers though, naturally, we can make no definite statement at the moment.

Readers say:

"R & H" CIRCUITS

I like your circuits. I have four radios now, and all are of Radio and Hobbies' design, including a push-pull radiogram. Incidentally I'm finding the joy of creation sadly tempered by expense, nowadays.

Next voyage I hope to rip apart a multimeter and build a VTVM following your April circuit. Bakelite and sheet aluminium appear to be off the market these days however.

Congratulations to your magazine, I get a lot of useful information from it.—(Mr. McP., S. S. River Clarence).

HE "SEES" MUSIC

I appreciate your leading articles being of the same mind on most matters. As far as television is concerned, do you know that sound shows itself in colors to those who can see? (clairvoyance). For instance, when the organ is played in a church, the sound can be seen coming through the roof, in clouds of different colors. Perhaps, with your great technical knowledge you may be able to make use of this in the future. (A. N., Lamb Island, Q.)

CAN'T COMPLAIN

Recently I completed a crystal set, using two coils. I now have it in operation and it is giving very pleasing results. I have been receiving Sydney which is about 300 miles away and Melbourne which is about 600 miles away but I cannot pick up our local station 2BE which is about 20 miles away. Could you please tell me why? (L. L. A. Tantawangle NSW.)

VALUE FOR MONEY

I have just built the Christmas Box Mantel and it's perfect — thanks to the clear diagrams and article on same, and I do not think you could buy a better set of its class.

We readers most certainly get a great service and store of knowledge for our modest outlay of 1/6.

Thanking you very much in the meantime. (F. H. Blacktown, NSW).

PENTODE OUTPUT FOR "SUPER THREE"

(Continued from Page 74)

or in conjunction with a suitable resistor, may be used in place of the 1000 ohm resistor, but unless one is already on hand, it is hardly justified, since it is considerably more expensive than the resistor and can hardly do a better job.

With the socket mounted as already mentioned, the pin positions work out very conveniently for simple wiring Pins one, two and three are the triode connections, including the common cathode, and the heater pins, four and five, provide a measure of shielding between this group and those from six to nine, which comprise the pentode connections.

Further shielding is provided by the socket, and it is essential that its central shield be earthed. This is most conveniently done with a link of wire to a solder lug fitted under the bolt which mounts the aluminium adaptor plate.

The remainder of the set is exactly as described last month and, whichever version you build, we feel that you will be more than pleased with the results it will give. We would be particularly interested to hear from those who do build it and to learn of its performance under varying conditions. We have an idea that this type of set is going to be very popular in the near future.

FRENCH OSCILLOGRAPH RECORDS POWER FAILURES

(Continued from Page 21)

The printed oscillographs may indicate

(a) the evolution of the fault, shape and duration of the short circuit, the overload, the out-of-balance of the phases, conditions of instability of the system, &c,

(b) the time protection-instruments take to work,

(c) the time of breaking—or automatic reclosing — of the circuit breakers,

(d) the sequence of signals transmitted by the carrier system and particularly the times required to allow the protection equipment to work properly.

The instrument is enclosed in a metal case and the mechanism assembled on an interior frame which can be swung out around two pivots for easy inspection. Two indicating lamps show when the instrument is operating and recording.

Listed in the table are the advantages of the Masson-Carpentier oscillograph over the usual photographic oscillograph.

Wanted to Buy, Sell or Exchange

FOR SALE: Williamson Amp and Pre-amp complete, £30. 3 valve TRF fitted with Philips PB unit, £10. Rola 120 Spkr., £3/10/-. Top cut filter, £2. All near new. **UY8056.**

FOR SALE: 1949 "Karset" partly wired, Power Unit completely wired, £19 Also Valves 2 6J7, 1 6V6, 1 6X5, 10/- ea. Boxes Radio Parts £1 include condensers, resistors, &c. **R. J. Maconachie, Diggers Rest, Barham 6.S.**

FOR SALE: Stamp collectors, my sets and singles for beginners or medium collectors are the "goods" in price and quality. Selections on request. **N. Cleary. St. Andrews, Victoria.**

FOR SALE: Portable BRS R-D-12 Recorder, complete with amplifier, Goldring lightweight Pickup, Microphone, in polished carrying case. BEST OFFER. Will sell less microphone. **W. G. Dale, C/o A. Murdoch, Hillvue, Sth. Tamworth.**

FOR SALE: 1 B.R.S. (S21) 16in Pickup. Complete with M.C.1 moving coil cartridge and TRIMAX MS860 transformer. Cost £40, practically unused—best offer. Apply **"Pickup," Box 14 P.O., Murrurundi, N.S.W.**

FOR SALE: 3 valve Transmitter 1, 6SN7GT 1, 6X5GT Broadcast Frequency £15 only. **R. Byrne, 3 Sorret Av., Malvern. Phone U2840 9 to 5.**

SALE: AC Zenith Mod. Osc. 180 kc to 25 mc. No. 11 Tx, Rx and Power supply. 1 Com. Rx, 2 RF stages and 3 IF stages. 1 Radiogram, partly built. Radio components and valves. **FY4301.**

SELL: Palec Valve and Circuit Tester Model VCT2. Guaranteed as new. Carrying case included, £42. **A. C. Robertson, 71 Market St., Randwick. or FA0455. Ext. 444. 9 am to 4 pm. Mon. to Fri.**

SELL: Ediswan Tape Recorder, excellent cond., 2 mics. and mic stands **FA1081. 59 Womerah Av., Darlinghurst. £90.**

SELL: Wavemeter, Crystal Calibrator. Tube Tester, quantity valves. Condensers, components **Hinckley, Oleander Drive, Ashgrove, Brisbane.**

SELL: Kingsley AR7, complete with rack, 10 metre box, FM adaptor, spare VIB, good order, £35 or best offer. **T. G. Kirk, Mt. Gambier, S.A.**

SELL: AWA 5-valve D/W Army amenities 6 volt VIB Receiver, in attractive grey waterproof steel case. Perfect order Suit boat or shack. £25 or offer. **T .G. Kirk, Mt. Gambier, S.A.**

SELL: Valves 815, 813, 866A 10/- ea. all new and guaranteed. **Johansen, 263 Stoney Creek Rd., Kingsgrove.**

SELL: Camera Agfa 120, Compur shutter, 8 speed f4.5, perfect condition as new, also case filters and hood. £18 lot. **18 Platts Av., Belmore.**

SELL: 35 M.M. Home Talkie Projector and films, £60. or offer. **Phone UU2281 Sydney.**

SELL: Recording unit, 2-17½in steel turntables, 1-6 HP induction motor, Royce Senior traverser, with 3-lead screws, "HI-FI" recording head, Audio-Scribe transcription pickup with Trimax transformer. Solidly built. Bargain, £45. Recording amplifier, 16 valves. P.P. 2A3's, bass and treble controls, 4 electronically mixed input channels, T.R.F. tuner. Steanes M.C. mike, Rola 120 speaker, 2 power supplies. Only £30. **K. Tilley, 24 Milroy St., E. Brighton, Vic.**

SELL: 1000 V.C.T., Trans. 500 mA, 400 mA, Chokes, 150 mA Chokes, Fil. Trans. High Watt Resis 10,000 ohms, 100,000 ohms, 750 CT Trans. 250 mA & other Radio parts. Cheap. Trans. and Chokes by Amer. Trans. Co. **170 Dunning Av., Roseberry.**

EXCH. Class C W/M for photo Enlarger, or sell; also qty. 6C4 VHF Triodes, 7/6. **32 Aeolus Av., Ryde. Phone 1573.**

EXCHANGE: Palec VCT Valve and Circuit Tester, AC Vibrator operation, needs new resistance in meter. (1) Multimeter type University no case, brand new, 2 radio courses, (1) Theory (1) Practical for FS6 Transceiver, complete with power supply, or will sell £30 the lot. Reply by letter, **E.J. Gray, Ferny Crk., Vic.**

EXCHANGE: 1 6SK7, 6SJ7, 6U70, 6V6, 6G8 for 1T4, 1R5 1T4, 1S5 3V4. **W. R. Toreaux, Marshal Rd., Holland Park, Q.**

EXCHANGE: R&H Jan., '44 to this issue, April and May, '44 missing; also "Hobbies Illustrated" No. 1, April '48, to March '50, 145 copies altogether. For offer in any of the following valves, 24A, 35, 42, 47, 75, 78, 6A7 80, or any type of Multimeter. **E. Howard-Davies, 36 Ethel St., Carlton, N.S.W.**

DO you want help by building that set? Radio-technician wants to help you. 7/- an hour and travelling expenses. After 5 o'clock or weekends only. Write **Box 6 Guildford P.O.**

WANTED: Communication Rcvrs., buy. Good prices. **LM3037. 57 Palace St., Petersham.**

WANTED full set of Coils for Kingsley Receiver, Type K/CR. A.R.7. **Ray Dorrington, Main St., Bairnsdale, Vic.**

WANTED: 2 coil Boxes for AR7 BC & 80M. **G. Esam, 38 Queen St. Colac.**

WANTED: Tpye A Mk. III Transceiver complete. **M. Madrick, Pinkilla, Quilpie, Queensland.**

ADJUSTING YOUR NEW XMITTER

(Continued from Page 61)

easy change-over from band to band, it involves a lot of wires and requires a large amount of space. Another approach is to erect one aerial of suitable length and feed it with well-insulated open wire lines.

If a suitable aerial tuning unit is installed, the whole system may be tuned to resonance on any one of several amateur bands. We intend to have more to say about this matter next month.

Incidentally, the new transmitter may be operated on the new 21.00 to 21.45 Mc band, which was made available to amateurs in Australia on the 1st May last. With a 7.00 Mc crystal there is plenty of drive when tripling to 21.00 Mc in the tritet stage with the 28 Mc coil in the plate circuit and the condenser adjusted to resonance.

The 28 Mc final tank coil may be resonated at 21 Mc, but since the L/C ratio is well away from optimum, it is desirable to wind a special coil. The data for a suitable coil is given here.

The 21 Mc band should be an excellent one for DX purposes, since it has characteristics midway between those of the familiar 14 Mc and 28 Mc bands. It also has the advantage that a directive aerial may be made of reasonably small dimensions.

21 Mc TANK COIL (L6)

11 T, 9 guage B & S enam. wire wound on a 1½in diam. former spaced 1½in. Centre tapped. Adjust L7 as necessary.

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